OCCURRENCE OF LAWN CARE AND AGRICULTURAL PESTICIDES IN THE DON AND HUMBER RIVER WATERSHEDS (1998-2002)

prepared for the

2002 CANADA-ONTARIO AGREEMENT RESPECTING THE GREAT LAKES BASIN ECOSYSTEM

Canada

Ontario

TORONTO
Works and Emergency Services

ISBN 978-1-4249-4986-1

Cover photograph © John and Ann Mahan

Occurrence of Lawn Care and Agricultural Pesticides in the Don and Humber River Watersheds (1998-2002)

February 2008

Canada

Ontario

TORONTO
Works and Emergency Services

PIBS 6291e
ISBN 978-1-4249-4986-1

This report is a collaborative study by Environment Canada, the Ontario Ministry of Environment and the City of Toronto, and contributes to delivery of commitments made by the federal and provincial governments under the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA). This report has been reviewed by members of the COA Annex Implementation Committee and approved by the COA Management Committee for publication as a COA document. However, the recommendations made in the report do not necessarily represent those of all signatory agencies of the COA.

Occurrence of Lawn Care and Agricultural Pesticides in the Don and Humber River Watersheds (1998-2002)

John Struger, Ecosystem Health Division, Environment Canada, Burlington, ON.
Tim Fletcher, Ecological Standards Section Standards Development Branch, Ontario Ministry of the Environment, Toronto, ON.
Greg Gris, Industrial Waste and Stormwater Quality Unit, Works and Emergency Services Department, City of Toronto, Toronto, ON.

Abstract

In 1998, a study of the Don and Humber River watersheds was initiated to determine the concentrations of pesticides in surface water, with a particular focus on those used in lawn care. Water samples were collected and analyzed for up to 152 pesticide active ingredients and eight metabolites, including phenoxy acid herbicides, organophosphorus insecticides, and other pesticides associated with lawn care use. Samples were collected from several sites in the Don and Humber River watersheds during base flow periods (i.e. dry events) and rainfall events (i.e. wet events) each year from 1998 through 2002.

An attempt was made to determine 1) whether there was a statistically significant difference in the detection frequency of pesticides between the two watersheds, as well as upstream and downstream of each river, and 2) whether precipitation influenced the frequency of detection. Due to the highly censored nature of the data (i.e. many samples below the detection limit) a novel non-parametric statistical approach was used to assess these data.

Eleven pesticides and one metabolite were detected in surface waters of the Don and Humber Rivers or their tributaries. These included 2,4-D, atrazine, bromacil, carbofuran, chlorpyrifos, cypermethrin, diazinon, dicamba, MCPP, metolachlor, metribuzin, and an atrazine metabolite (des-ethyl atrazine). Approximately 72% of samples contained at least one pesticide attributable to lawn care use (i.e. diazinon, chlorpyrifos or phenoxy acid herbicide) at a detectable concentration.

Water quality criteria (CCME Canadian Water Quality Guidelines or Ontario Provincial Water Quality Objectives) were exceeded for four pesticides. Diazinon exceeded the Provincial Water Quality Objective for the Protection of Aquatic Life in 28% of the samples taken. For the other three pesticides (atrazine, carbofuran, and chlorpyrifos) exceedence of a water quality criteria occurred in less than 1% of the samples. Since diazinon was the pesticide most frequently detected above its water quality criteria, it can be suggested that the occurrence of this pesticide could have the greatest potential to impact the health of aquatic organisms.

1.0 Introduction

Pesticides are highly regulated in Canada, they undergo a thorough human health and environmental assessment prior to their registration for sale and use in Canada. Prior to the mid-1970s, organochlorine chemicals such as DDT and chlordane were used for pest control. These chemicals are highly persistent, have very low water solubility, a high affinity for sediment, and a potential to biomagnify in the food chain. Their use has subsequently been banned. In contrast, modern pesticides used in agriculture and home gardens are relatively non-persistent. They generally have a low affinity for sediment and do not biomagnify (Table 1). Pesticides that are highly soluble would be expected to be more mobile through run-off and would be more likely to be detected in surface waters. Long term exposure to a continuous input of these pesticides through the application season may still have the potential to impair the health of aquatic ecosystems and requires evaluation.

Table 1: Environmental Fate of Detected Pesticides

Pesticide Type	Pesticide	Persistence in Surface Waters	Log Kow[1]	Solubility (mg/L)
Phenoxy broad-leaf herbicide	**2,4-D**	1 to several weeks	2.81	890
Triazine broad-leaf herbicide	**Atrazine**	Several weeks	2.52	33
Uracil non-selective herbicide	**Bromacil**	2 months in river water	2.61	815
Carbamate insecticide	**Carbofuran**	Persistent at low pH (not relevant)	1.23-1.41	320
Organophosphate insecticide	**Chlorpyrifos**	Can persist in water for several weeks	5.27	0.40
Synthetic pyrethroid insecticide	**Cypermethrin**	Hydrolysis T ½ > 50 days; photo-degradation T ½ > 100 days	6.06	0.004
Organophosphate insecticide	**Diazinon**	T ½ up to 6 months	3.3	60
Phenoxy broad-leaf herbicide	**Dicamba**	Up to several weeks	0.48	6500
Phenoxy broad-leaf herbicide	**Mecoprop**	N/A	3.43	44
Acetanilide broad-leaf herbicide	**Metolachlor**	Moderately persistent (up to 200d in basic waters)	3.28	530
Triazine broad-leaf herbicide	**Metribuzin**	T ½ of 7d in pond water	1.58	1220

[1]Log Kow is a predictor of a chemical's ability to bioaccumulate in aquatic organisms. Chemicals with a log Kow < 4.0 will likely not bioaccumulate.

References:
EXTOXNET 2004
Mackay et al. 2000
RAIS 2004

In 1994, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA 1994) published the results of their 1993 Pesticide Use Survey. While later surveys (i.e. 1998, 2003) reported only agricultural use, this earlier survey also included responses from

professional lawn care applicators. The total amount of active ingredients used in Ontario was extrapolated from the responses received. Table 2 lists the active ingredients used most frequently (as a percentage of the total amount of all pesticide active ingredients used in this sector) by Ontario lawn care applicators, although other types of applicators were also surveyed (e.g. forestry). These ten pesticides account for approximately 95% of the total amount of active ingredients estimated to be applied by professional applicators. According to the survey responses, approximately 60% of the pesticides that were used by professional applicators were applied to residential lawns (OMAFRA 1994).

Table 2: Active Ingredients Most Frequently Used by Professional Applicators in Ontario (from OMAFRA 1994)

Active Ingredient	% of Total Use Reported
Mecoprop[1]	19.34
2,4-D[1]	17.28
Dicamba[1]	14.61
Diazinon[1]	9.80
Chlorpyrifos[1]	9.66
2,4-DB[2]	7.82
Dichlorprop (2,4-DP)[1]	8.04
MCPA[1]	3.72
Bacillus thuriengensis[2]	3.08
Glyphosate[3]	1.43

[1]Primarily used by lawncare applicators

[2]Primarily used by forestry applicators

[3]Mostly used by forestry applicators (Vision ®) but also in lawncare (e.g. Roundup®)

There have been a number of recent surveys investigating the use of pesticides on residential lawns and whether application was conducted by professional applicators or private home owners (Struger et al. 1994, City of Waterloo unpublished, TPHD 2002, CMCS unpublished). Overall, these homeowner surveys indicate that approximately half of the lawns are treated and half are not. Some variability in pesticide use from city to city is expected, especially in those municipalities where a high level of discussion on pesticide use reduction has occurred (e.g. Waterloo and Toronto).

Urban development results in significant changes to urban watershed hydrology. Large natural areas become compacted during construction and are replaced with impervious surfaces (e.g. pavement) which impede infiltration. As well, installation of stormwater drainage systems (i.e., storm sewers) delivers water much more quickly and efficiently to receiving waters. More rainfall is converted to surface water, run-off occurs more quickly, and peak flows become larger (Center for Watershed Protection 2003). As a result, aquatic biota may be at risk from these in-use pesticides because of the proximity of lawns in urban areas to stormwater drainage systems. Stormwater inputs of these pesticides would be expected to be highest during runoff events occurring immediately following pesticide application to lawns. In addition to stormwater inputs, recent work has suggested that significant loads of pesticides in surface water (possibly greater than 40%) may be contributed by pesticides contained in rainwater and other precipitation from atmospheric transport (McConnell et al. 1997; McConnell et al. 1998; Kuang et al. 2003).

The watersheds of the Don and Humber Rivers are the two largest draining the City of Toronto and surrounding areas. Both have headwaters above the city, in rural areas. The

Humber River watershed drains an area of 907 km^2 of which, approximately, 46% is agricultural and 24% is residential, industrial or commercial land use (TRCA 2003). Agricultural uses are primarily production of livestock and cash crops on the Oak Ridges Moraine, South Slope, and Peel Plain in the Towns of Caledon and Vaughan in King Township (CHRS 2001). Much of this area drains to the West Humber. The Don River watershed drains 360 km^2, of which approximately 2% is agricultural and 65% is residential, industrial or commercial land use (TRCA 2003).

Due to a greater awareness of environmental issues, public concern has grown recently regarding the use of pesticides, particularly in urban environments. Concern over the effects of pesticide use on human and environmental health has resulted in a number of communities in Canada (including Toronto) instituting municipal by-laws banning or restricting the use of lawn care pesticides. On the basis of total kilograms applied, agricultural pesticide use is greater than urban pesticide use, although they are applied over a large land area. However, urban applications are still significant (Hoffman et al. 2000). While agricultural pesticide application timing tends to be more restricted to the early spring, urban residential applications tend to be more diffuse, occurring throughout the growing season from early spring through late fall. The number of applications may be higher on urban lawns as many product labels recommend at least two applications (and sometimes more) throughout the growing season to control weeds. A comprehensive study of pesticides in urban streams has been conducted in the United States (USGS 1999, Hoffman et al. 2000), and more recently, Phillips and Bode (2002, 2004) investigated the influence of urbanization and precipitation on pesticide concentrations in streams in New York State. These studies found that a large number of pesticides are present in water from streams draining developed areas and that the most frequently detected pesticides included those estimated to be among the most heavily used in developed areas. These studies also found that a number of water quality criteria for the protection of aquatic life were exceeded in urban streams. It is still not known whether the same can be said for tributaries in Ontario as there is little pesticide monitoring data available for urban streams.

The objectives of this study were:

- to determine the concentrations of pesticides in surface waters of the Don and Humber Rivers and some of their tributaries
- to determine whether urban (lawn care) inputs of pesticides from within the City of Toronto could be distinguished from agricultural and other pesticide inputs upstream of the City by comparison of upstream and downstream pesticide concentrations
- to determine possible spatial and temporal trends in concentrations
- to identify possible environmental concerns by comparing ambient concentrations to available federal and provincial water quality criteria
- to investigate whether golf course turf care contributed to elevated pesticide concentrations in one location on the Humber River.

2.0 Methods

2.1 Field Sampling

The sampling locations for this study are shown in Figure 1. Between 1998 and 2000, water samples were collected from the lower reaches of the Don and Humber Rivers (Stations 9 and 1, respectively), Wilket Creek in the Don River watershed (Station 7), and two locations on a tributary of the Humber River flowing through the municipally operated Scarlett Woods Golf Course (Stations 3 and 4). Station 2 was a grass swale on this golf course and data from this site are omitted from this report since there was rarely any water at this location resulting in minimal sample collection. In 1999 two additional sampling stations were added to the study. These were the West Don River at Steeles Avenue (Station 6) and the West Humber River at Gorewood Drive (Station 5). A comparison of pesticide concentrations measured at the sites upstream of the City of Toronto with those at the lower end of the Don and Humber Rivers should indicate whether additional pesticides were being introduced into the urbanized Toronto area.

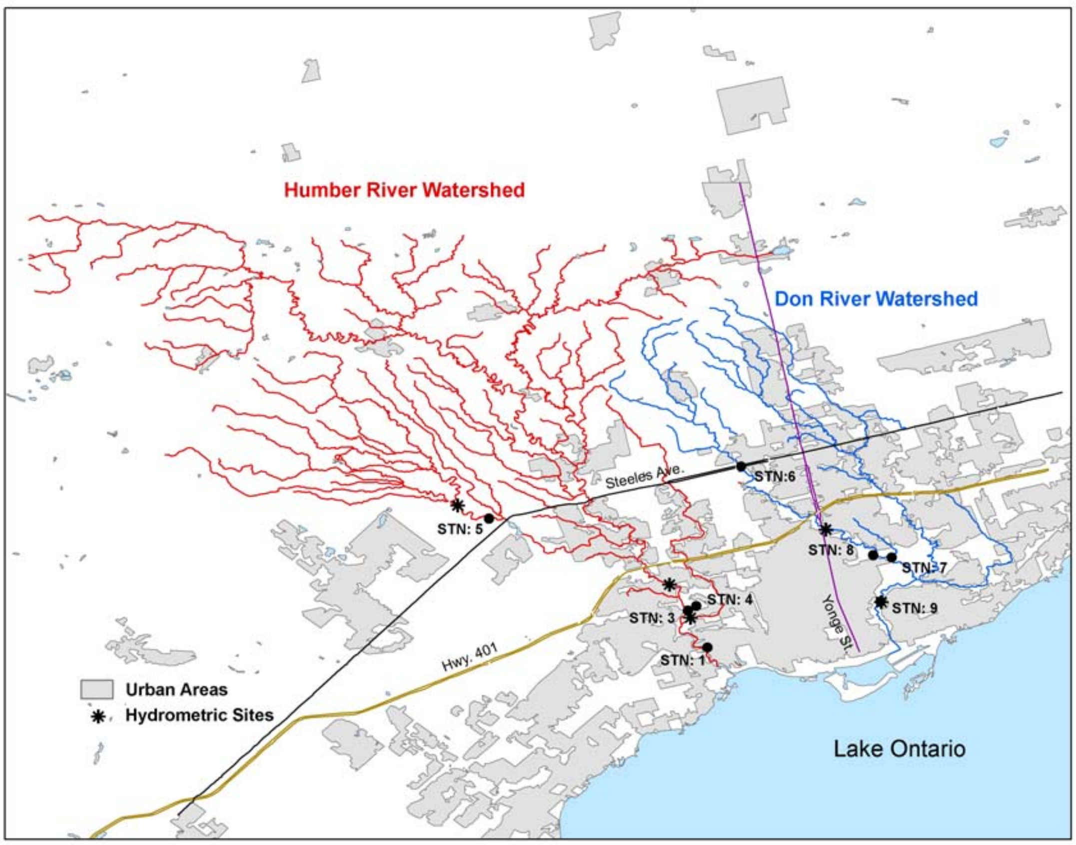

Figure 1: Map of the Don and Humber River Watersheds Indicating the Location of the 8 Sampling Sites (Grey Shading Shows Urbanization).

In 2000, an additional site on Burke Brook in Sherwood Park in the Don River watershed (Station 8) was added at the request of the City of Toronto. All sites were sampled in 2001. In 2002, only the two sites on the lower reaches of the rivers (Stations 9 and 1) were sampled as part of the Ontario Ministry of Environment Enhanced Tributary

Monitoring Program. As a result, these two stations were the most frequently sampled over the period of the study.

Individual grab water samples were collected by either City of Toronto (1998 to 2001) or Ontario Ministry of Environment (2000 to 2002) contract staff during both rainfall events (wet events) and base flow periods (dry events). A total of 262 samples were collected from 1998 to 2002 where 123 samples were collected during wet events and 139 samples were collected during dry events. Sampling frequency varied from year to year (Table 3). When possible wet event samples were collected either a short time after the start of precipitation in an attempt to collect first flush conditions, or during the peak flow periods. Figure 2 illustrates the relation between river flow, localized precipitation and sample collection. Note the difference in amount of precipitation between the two precipitation monitoring stations. The greatest pesticide run-off is expected to occur at these times. Base flow samples were collected during periods when the flow curve was flat (Figure 2).

Table 3: Sampling Program

Year	Sampling Frequency	No. of Samples	Dry Events	Wet Events
1998	April through December	15	10	5
1999	March through November	78	36	42
2000	August through November	40	30	10
2001	April through October	91	37	54
2002	February through December	38	26	12
	Totals	**262**	**139**	**123**

Three or four surface water samples were collected (by gloved hand) at each site in pre-washed 1 L glass bottles (University of Guelph SOP# 955-013-AMSCO470 Washer). Samples were collected from mid-stream, 10 to 15 cm below the surface, where possible. They were kept in coolers in the field and refrigerated in the lab until analysis by the Laboratory Services Division, University of Guelph. Analyses included phenoxy acid herbicides, organophosphorus insecticides and carbamate pesticides. Many of these pesticides are used in both lawn care and agricultural pest control programs. In addition, samples were also analyzed for the triazine herbicides which are exclusively used in agriculture.

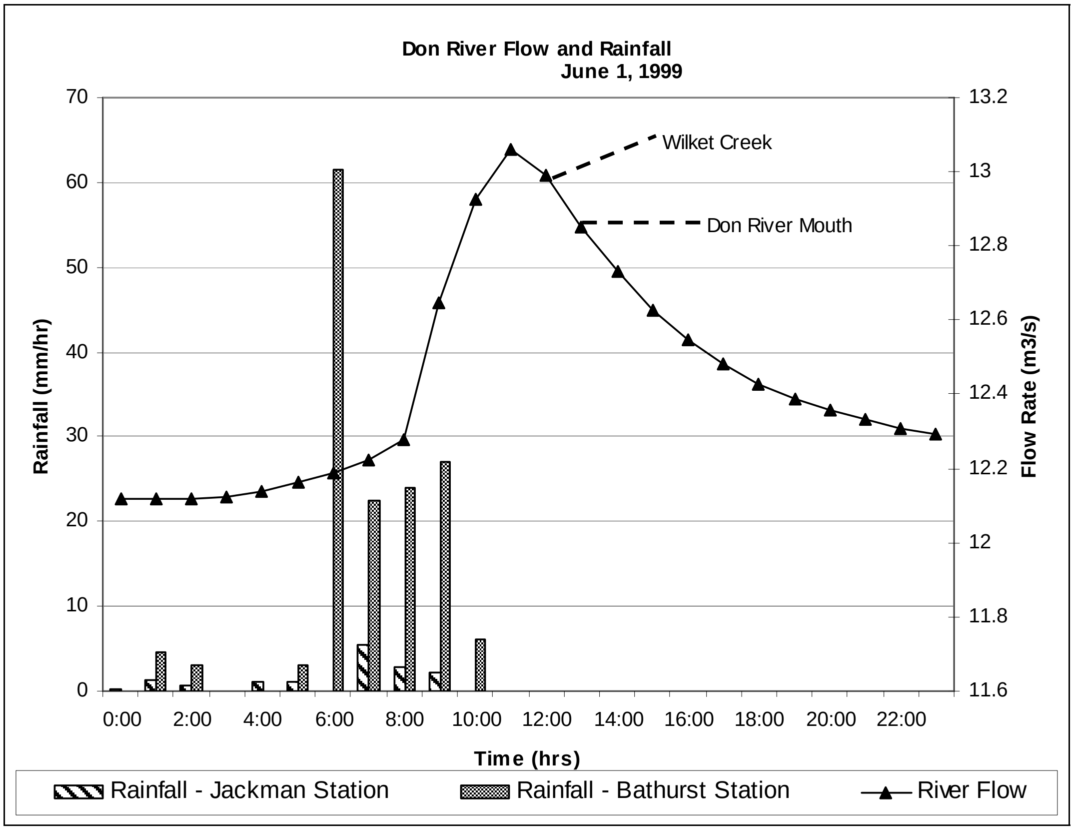

Figure 2: Example of Wet Event Sampling Times in Relation to Streamflow and Rainfall at Two Locations on the Don River. Site Indicator marks are intended to show relative flow increase as a result of rainfall.

2.2 Analytical Methodology

Samples were analyzed by the University of Guelph's Laboratory Services Division. All analytical methods, except that for imidacloprid, have been accredited through the Standards Council of Canada/ Canadian Association of Environmental Analytical Laboratories (SCC-CAEAL) partnership. One hundred and fifty-two pesticide active ingredients (herbicides, insecticides and fungicides) and eight metabolites were analyzed (listed in Section 8.0). Many of the analytical methods used detected a series of related pesticides (e.g., organophosphorus, organochlorine), which accounts for the large number of pesticides listed. The focus of this study was on pesticides commonly used in lawn care and, except for *Bacillus thuriengensis* (a biological pesticide commonly used in forestry), all of the most frequently applied pesticides (Table 2) were monitored for in surface water.

There were slight variations in the number of pesticides analyzed from year to year. Laboratory recoveries for the various classes of pesticides were within acceptable ranges. Laboratory blanks demonstrated that the system was free from internal contamination. Field blanks were collected and contained no detectable pesticide residues.

Organophosphorus Insecticides, Organonitrogen Pesticides, Organochlorine Pesticides, Carbamate Insecticides, Triazine Herbicides, and Imidacloprid Determination

Water samples (1 L) were extracted twice with 100 ml of dichloromethane by shaking for one minute after the addition of 50 ml of aqueous saturated sodium chloride solution. The extracts were dried with anhydrous sodium sulphate and evaporated just to dryness. The residual material was re-dissolved in 5.0 ml of hexane. The organophosphorus insecticides, organonitrogen and organochlorine pesticides, carbamate insecticides, and triazine herbicides were analyzed using a capillary column gas chromatograph equipped with a nitrogen phosphorus detector. An extra florisil cleanup step was used in the extraction process for organochlorine pesticides. Imidacloprid was analyzed using high performance liquid chromatography with an ultra-violet detector.

The method detection limit (MDL, as defined by USEPA 1997) for most of the organophosphorus insecticides and for triazine herbicides was 0.05 ug/L. For organonitrogen, organochlorine and carbamate pesticides the MDL was 0.1 ug/L, and for imidacloprid the MDL was 1.0 ug/L. For diazinon and atrazine the MDL was 0.02 ug/L.

Glyphosate Determination

A 20 ml aliquot of the water sample was evaporated to dryness and reconstituted in 1.0 ml of the mobile phase solvent(s). This extract was examined using high performance liquid chromatography (HPLC) with a Post Column Reaction System and fluorescence detection to determine glyphosate and its metabolite AMPA. The MDL for both glyphosate and AMPA was 0.05 ug/ml (50 ug/L).

Phenoxy Acid Herbicide and Dithiopyr Determination

An 800-ml aliquot of the water sample was acidified using ^{18}N H_2SO_4 and extracted with 90 ml of ethyl acetate by tumbling for 1 hour using a tumbler apparatus. After tumbling, the contents were extracted with an additional 25 ml of ethyl acetate and the combined extracts were dried with anhydrous sodium sulphate. Two ml of 2,2,4-trimethylpentane was added as a keeper, and evaporated to almost dryness. This extract was redissolved in 8.0 ml of ethyl acetate. Four ml were removed for dithiopyr analysis and the remaining 4.0 ml were evaporated and derivatized by adding 3.0 ml of diazomethane to the extract and letting it stand for 30 minutes. The contents were then evaporated just to dryness using a pure nitrogen stream. The residual material was re-dissolved in 2.0 ml of 2,2,4-trimethylpentane for phenoxy acid herbicide analysis. The phenoxy acid herbicide and dithiopyr residues were determined separately using capillary column gas chromatography with a mass selective detector (GC-MSD). The MDLs were 0.1 ug/L for the phenoxy acid herbicides and 10 ug/L for dithiopyr.

Ethylenebisdithiocarbamate (EBDC) and Dimethyldithiocarbamate Fungicide Determination

Dithiocarbamate was decomposed with hot mineral acid and stannous chloride to form an amine and carbon disulphide. The gases were drawn through two adsorption traps. The

first trap contained NaOH and benzene to capture any hydrogen sulphide formed. The second trap contained Cullen's chromogenic reagent to react with any carbon disulphide generated to form a coloured complex. The absorption was measured spectrophotometrically at 435 nm. The MDL was 5 ug/L. This method is suitable for the determination of total dithiocarbamates, as EBDC equivalent carbon disulphide (CS_2), in various substrates, including water, soil, fruit, and vegetables.

2.3 Statistical Analysis

Statistical analysis of the data was performed by Zajdlik and Associates under contract to the Ontario Ministry of Environment (Zajdlik and Associates, Inc., unpublished). All data analyses were conducted using Splus Professional 6.1, Release 1 (Insightful Corp 2002).

The following null hypotheses were tested:

1. The concentrations of the Chemicals of Potential Concern (COPC; i.e., lawn care pesticides) in the Don and Humber Rivers are the same upstream and downstream.

2. The concentrations of COPC are the same in the Don and Humber Rivers.

3. There is no effect of precipitation on concentrations of the COPC in the Don and Humber Rivers.

4. There are no seasonal or monthly patterns in the concentrations of the COPC in the Don and Humber Rivers.

5. The concentrations of the COPC in the Don and Humber Rivers are the same across years.

6. The concentrations of the COPC are the same in Burke Brook and Wilket Creek.

A large proportion of the pesticide measurements were below method detection limits (MDLs) making the use of simple (i.e., parametric) statistical tools problematic. As an alternative, counts of measurements falling into each of three classes – zero, between zero and the MDL, and greater than the MDL – were used (i.e. non-parametric statistics). In performing the statistical analyses, values reported by the analytical laboratories as "ND" (i.e., not detected) were entered as 0, and values reported as "MDL" were entered as half the detection limit. These counts were expressed as a function of the variable of interest. For example, the effect of rainfall was tested by comparing measurements taken following a rainfall event to those taken during dry periods. However, when testing whether rainfall has an effect on pesticide concentrations, the effect might be different across watersheds, for a variety of hydro-geological reasons. The effect of watershed (or other potentially confounding variables for which information was available) was removed using a statistical model (log-linear model under the generalized linear model framework (McCullagh and Nelder 1994)) and the effect attributable only to rainfall, was

tested for significance. A result was only labeled as statistically significant if it was at least 95% certain that it was not due to chance alone (i.e., $p \leq 0.05$).

3.0 Results

3.1 Study Summary

Table 4 lists the pesticide groups which were analyzed for in the Don and Humber River surface waters collected from 1998 to 2002. A detailed list of these pesticides and metabolites can be found in Section 8.0.

Table 4: Pesticides Analyzed by Year

Year	1998	1999	2000	2001	2002
Pesticides/ Pesticide Groups Analyzed	Organophosphorus Insecticides Carbamate Insecticides Phenoxy Acid Herbicides Triazine Herbicides Organochlorine Insecticides Pyrethroid Insecticides EBDC Fungicides	Organophosphorus Insecticides Carbamate Insecticides Phenoxy Acid Herbicides Triazine Herbicides Organochlorine Insecticides Pyrethroid Insecticides EBDC Fungicides	Organophosphorus Insecticides Carbamate Insecticides Phenoxy Acid Herbicides Triazine Herbicides Glyphosate/ AMPA (metabolite) Imidacloprid Dithiopyr	Organophosphorus Insecticides Carbamate Insecticides Phenoxy Acid Herbicides Triazine Herbicides Imidacloprid Dithiopyr	Organophosphorus Insecticides Carbamate Insecticides Phenoxy Acid Herbicides Triazine Herbicides

In the study, a total of 262 surface water samples were collected. Of the 152 pesticides and 8 metabolites that were analyzed for, eleven pesticides and one metabolite were detected (Table 5). These compounds were: 2,4-D, atrazine, an atrazine metabolite (des-ethyl atrazine or DEA), bromacil, carbofuran, chlorpyrifos, cypermethrin, diazinon, dicamba, MCPP, metolachlor and metribuzin. Under Pesticide Type, Table 1 provides a brief description of the use of these pesticides and Section 9 provides the data by site location. Five of these pesticides (2,4-D, diazinon, dicamba, chlorpyrifos and MCPP) are commonly used for urban turf management, but are also used in agriculture. The highest in-use pesticide concentration measured in the study was 3.6 ug/L of atrazine (West Humber River; Table 7), which was double the Canadian Water Quality Guideline (CWQG) for the Protection of Aquatic Life. This was followed by 2,4-D (3.2 ug/L in Wilket Creek, below the CWQG) and carbofuran (3.0 ug/L at the Scarlet Woods Golf Course, 1.7 times the CWQG) [CCME 1999]. Approximately 72% of samples contained at least one pesticide attributable to lawn care use (i.e. diazinon, chlorpyrifos or phenoxy acid herbicide) at a detectable concentration.

There was no detection of an organochlorine pesticide, EBDC fungicide, or the three lawncare chemicals of special interest (ie. glyphosate, imidacloprid or dithiopyr).

Table 5: Summary of Surface Water Pesticide Monitoring Results (1998 through 2002)

Pesticide	Water Quality Criteria - WQC (ug/L)	Method Detection Limit (ug/L)	Maximum Concentration Detected (ug/L)	Frequency of Detection (% of samples)	Frequency of WQC Exceedence (% of samples)
2,4-D	4[a]	0.1	3.2	12.2	0
Atrazine	1.8[a]	0.02	3.6	11.1	0.8
Des-ethyl Atrazine	-	0.05	1.7	0.8	-
Bromacil	-	0.1	1.7	4.2	-
Carbofuran	1.8[a]	0.1	3.0	0.8	0.4
Chlorpyrifos	0.001[b]	0.05	0.52	0.4	0.4
Cypermethrin	-	0.05	0.38	0.4	-
Diazinon	0.08[b]	0.02	1.0	36.3	27.5
Dicamba	10[a]	0.1	2.2	2.7	0
MCPP (Mecoprop)	4[a]	0.1	2.4	39.7	0
Metolachlor	7.8[a]	0.05	1.6	5.0	0
Metribuzin	1[a]	0.05	0.12	0.4	0

[a] – Canadian Water Quality Guideline for the Protection of Aquatic Life
[b] – Provincial Water Quality Objective for the Protection of Aquatic Life
- No water quality criteria available

The most frequently detected pesticides were MCPP (detected in almost 40% of the samples), followed by diazinon (over 36%) and 2,4-D (over 12%) as shown in Table 5. All three pesticides are commonly used for residential lawn care, however they are also used in agriculture. All other compounds were detected less frequently. Water Quality Guidelines/Objectives were exceeded for four of the pesticides. For diazinon, the Ontario Provincial Water Quality Objective (PWQO) for the Protection of Freshwater Aquatic Life (OMOE 1994) was exceeded in approximately 28% of the samples. Carbofuran was detected at the mouth of the Humber River and in Scarlett Woods Creek (Station 4), upstream of the golf course on the Humber River watershed. It exceeded the CWQG one time at the Scarlett Woods Creek site (0.38%). Carbofuran is used exclusively in the agricultural sector. Atrazine exceeded the Canadian Water Quality Guideline on two occasions (0.76% of samples). Both samples were from the West Humber River in 2001. Chlorpyrifos was detected once (0.38%) in the West Don River at a concentration which exceeded the PWQO. Table 6 provides a summary of pesticides detected, by sample location, throughout the course of this study.

3.2 Humber River Watershed

3.2.1 West Humber River

There were 25 samples taken from the West Humber River over the course of the survey. In total, six pesticides were detected over the course of the study (Table 6). Two of these (atrazine and metolachlor) are only registered for agricultural use in Ontario. The other pesticides have both agricultural and lawn care uses. The most frequently detected pesticide was atrazine which was present in 48% of samples followed by mecoprop (44%), diazinon (40%) and metolachlor (28%). Two pesticides (Table 7) were detected at concentrations greater than current water quality criteria. Diazinon had the greatest number of exceedences (24% of samples) as well as the greatest single exceedence (5 times PWQO). Atrazine exceeded the Canadian Water Quality Guideline twice (8%).

Table 6: Pesticides Detected by Location (1998 through 2002)

Watershed	Location	Station ID	# of Samples	Pesticides Detected
Humber	West Humber River	STN5	25	2,4-D; Atrazine; Diazinon; Dicamba; MCPP; Metolachlor
Humber	Humber River Mouth	STN1	61	2,4-D; Atrazine; Carbofuran; DEA; Diazinon; Dicamba; MCPP; Metolachlor; Metribuzin
Humber	Scarlett Woods Golf Course	STN4 (Upstream)	25	Atrazine; Carbofuran; Diazinon; MCPP, Metolachlor
		STN3 (Downstream)	26	2,4-D; Atrazine; Diazinon; MCPP
Don	West Don River	STN6	24	2,4-D; Atrazine; Bromacil; Chlorpyrifos; Diazinon; MCPP; Metolachlor
Don	Don River Mouth	STN9	60	2,4-D; Atrazine; Bromacil; Cypermethrin; Diazinon; Dicamba; MCPP; Metolachlor
Don	Burke Brook	STN8	13	2,4-D; Atrazine; Diazinon; MCPP
Don	Wilket Creek	STN7	28	2,4-D; DEA; Diazinon; Dicamba; MCPP, Metolachlor

3.2.2 Humber River Mouth

There were 61 samples taken from the Humber River mouth station over the course of the survey. In total, eight pesticides (Table 6) and one pesticide metabolite were detected. Metribuzin is only registered for agricultural uses in the province. One possible reason for metribuzin detection at the mouth and not at the upstream site may be that the source was from one of the other upper tributaries of the Humber River that also flow through agricultural lands and not the West Humber River tributary which was sampled in this study. The most frequently detected pesticide was MCPP which was present in 44% of samples followed by diazinon (36%), atrazine (15%) and 2,4-D (10%). Once again, diazinon had the greatest number of exceedences (30 %) and the greatest single exceedence (8.75 times PWQO).

Table 7: Summary of Results for Humber River Watershed (1998 to 2002)

	West Humber River		Humber River Mouth	
Pesticide	**Max. Detection (ug/L)**	**Frequency of Detection (%)**	**Max. Detection (ug/L)**	**Frequency of Detection (%)**
2,4-D	0.8	4	1.4	9.8
Atrazine	3.6	48	1.1	14.8
Carbofuran	ND	-	1.0	1.6
DEA	ND	-	1.0	1.6
Diazinon	0.4	40	0.7	36
Dicamba	2.2	12	0.6	3.28
MCPP	1.1	44	1.7	44.26
Metolachlor	1.6	28	1.6	8.2
Metribuzin	ND	-	0.12	1.64

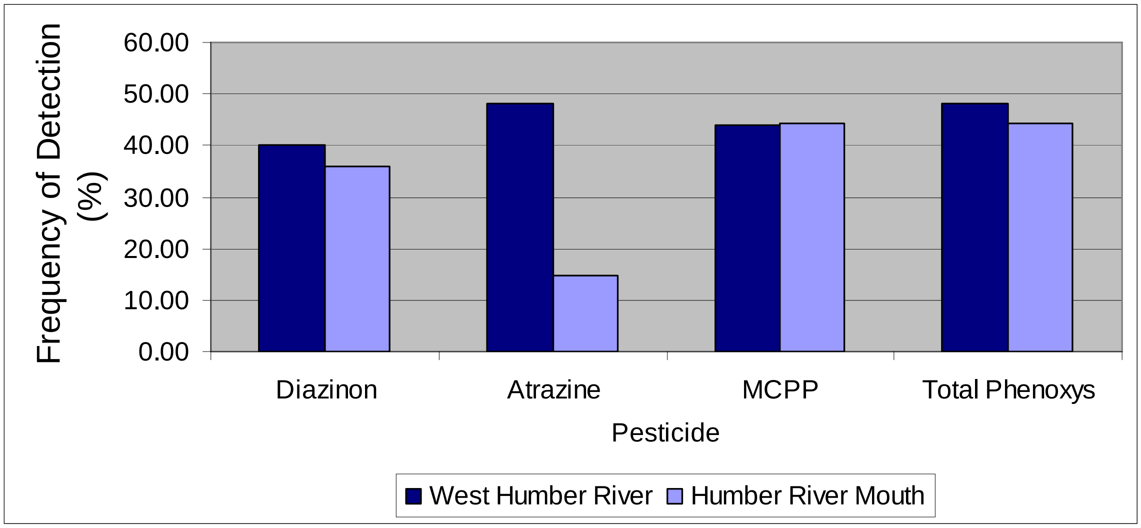

Figure 3: Detection of Pesticides in the Humber River Watershed.

The concentration and frequency of detection of atrazine was significantly elevated in the Humber River at upstream locations compared to downstream locations ($p = 0.0001$; Figure 3). Atrazine is used only in agriculture. Additional atrazine inputs are unlikely as the river flows through a primarily urban area. In addition, there are tributaries that feed into the lower Humber River which do not drain agricultural lands. Thus, the lower detections at the downstream site may be the result of dilution from the remainder of the Humber River drainage system. While some environmental degradation of atrazine would occur, atrazine can persist for several weeks in surface water (Table 1), and therefore, lower concentrations in the downstream locations would primarily be due to dilution. Other pesticides did not show a statistical difference between upstream and downstream locations which may reflect further urban inputs of these pesticides.

3.2.3 Scarlett Woods Golf Course

In total, 51 water samples were collected from two sites located on a small tributary flowing through the Scarlett Woods Golf Course located in the City of Toronto. The first site (STN 4) was located upstream of the golf course near Jane St. and Eglinton Ave. and the second site (STN 3) was located downstream of the golf course just before entering the main branch of the Humber River.

Between 1998 and 2001, 10 wet event samples and 15 dry event samples were collected from both stations. Based on these limited samples, the golf course did not appear to be a significant source of pesticides. While 2,4-D was detected in one sample at the downstream sample location but not at the upstream site, two other pesticides (metolachlor and carbofuran) were detected above the golf course but not at the downstream site. Pesticide detections in the golf course tributary were overall lower than most of the other sampling sites. A possible explanation for this may be a result of the efforts by the City of Toronto's Parks Department to reduce pesticide use at the Scarlett Woods Golf Course by implementing Integrated Pest Management (IPM) and other

pesticide reduction practices and that applications were made in such a way that runoff and/or other contamination was avoided by the proper and judicious use of pesticides by trained and licensed applicators. However, further sampling at these stations during the peak pesticide use season is needed to confirm that the golf course is not contributing to pesticide run off.

A number of fungicides (anilazine, chloroneb, chlorothalonil, iprodione, thiophanate-methyl and quintozene) were used on the city owned golf courses . However, none of the three fungicides (i.e., chlorothalonil, iprodione and quintozene) that were included in the analytical scan were detected in any water sample. The herbicides 2,4-D and mecoprop are typically applied to control broad-leaved weeds on turf and the insecticide diazinon is used to control turf insect pests. Detections of these pesticides may be a result of golf course use or input from upstream users.

The detection of carbofuran, atrazine and metolachlor at the upstream golf course site is difficult to explain since all of these pesticides are currently only registered for agricultural use. However, there is no agricultural land upstream of the golf course. The small creek that flows through the golf course is completely buried upstream of the sampling location and receives primarily stormwater run-off. One possibility for the detection of these pesticides is non-approved use upstream. Another explanation for the detection of these pesticides may be that they are the result of inputs from precipitation and atmospheric deposition, which has been documented in a number of studies (Goolsby et al 1997; Hall et al. 1993; McConnell et al. 1997; McConnell et al. 1998; Kuang et al. 2003). Hoffman et al (2000) concluded that the most likely source of agricultural pesticides detected in streams that drain developed, non-agricultural areas is atmospheric drift from agricultural lands. However, one would expect to see traces of agricultural pesticides at all locations in the watersheds if this were the case.

3.3 Don River Watershed

3.3.1 West Don River

A total of 24 samples were collected from the West Don River. In total, seven pesticides were detected (Table 8). The most frequently detected pesticide was MCPP which was detected in almost 63% of samples taken, followed by diazinon (50%), bromacil (37.5 %) and 2,4-D (17%). Concentrations of diazinon exceeded the PWQO in about 21% of samples. Chlorpyrifos was detected in only one sample, but greatly exceeded the PWQO (520 times higher). The frequent detection of bromacil (37.5%) is interesting to note. All products containing bromacil are registered for Commercial use only and are primarily used for controlling broadleaf weeds, grasses and brush on non-cropland areas, such as utility transmission lines, airports, right of ways, railroads, etc. (PMRA 2004). Further sampling and trackdown would be required to determine if any of these land uses are upstream of this location and are the source of bromacil in surface water.

3.3.2 Don River Mouth

There were 60 samples taken from the mouth of the Don River between 1998 and 2002. Eight pesticides were detected (Table 8) over the course of the study. The most

frequently detected pesticide was MCPP, which was detected in 55% of samples. Diazinon was detected in 45% of samples and the PWQO for diazinon was exceeded in all but one of the samples where detected. 2,4-D was detected in 19.5% of samples. Other pesticides detected included bromacil, atrazine, dicamba, metholachlor and cypermethrin. This was the only location that cypermethrin was detected in the course of this study.

Statistical analysis showed that concentrations and frequency of detection of pesticides were not significantly different between the upstream and downstream locations on the Don River. The frequency of detections of MCPP, diazinon, atrazine and total phenoxy herbicides were similar at both locations (Figure 4). It is interesting to note this fact, particularly for the agricultural pesticides, for which it would have been expected to observe a similar decline as was seen in the Humber River samples. Since the Don River is still heavily urbanized upstream of the upstream sampling location, it may have been useful to select a sampling location closer to agricultural land-use (i.e., even further upstream) in order to be able to quantify agricultural pesticide inputs to the river. Once again, atmospheric inputs may also be contributing to the detection of these agricultural pesticides in an urban waterway and/or their detection may be the result of non-approved use of pesticides within the drainage area.

Table 8: Summary of Pesticide Detection in the Don River

	West Don River		Don River Mouth	
Pesticide	**Max. Detection (ug/L)**	**Frequency of Detection (%)**	**Max. Detection (ug/L)**	**Frequency of Detection (%)**
2,4-D	1.4	16.7	1.6	19.5
Atrazine	0.14	4.2	0.1	6.7
Bromacil	1.7	37.5	0.23	4.9
Chlorpyrifos	0.52	4.2	-	-
Cypermethrin	-	-	0.38	1.67
Diazinon	0.27	50	1	45
Dicamba	-	-	0.7	2.4
MCPP	1.4	62.5	2.4	55
Metolachlor	0.05	4.2	1.3	4.9

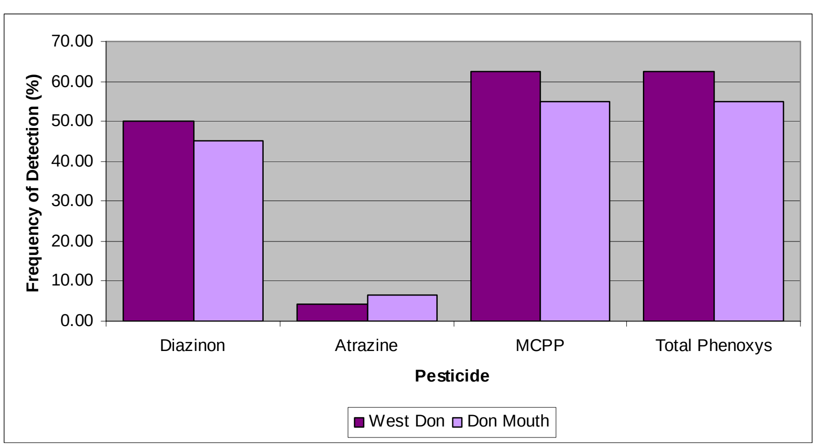

Figure 4: Detection of Selected Pesticides in Don River.

3.3.3 Burke Brook

Burke Brook is situated in a heavily urbanized part of the City of Toronto and feeds into the West Don River. Some areas of the watercourse have been significantly modified through straightening, ditching and tunneling in order to accommodate excess storm water. Work is currently underway to return the brook to as natural a state as possible (City of Toronto 2004). A total of thirteen water samples were taken from the brook in 2000 and 2001. Five pesticides were detected. Diazinon was detected in approximately half of these samples, and the PWQO was exceeded in over a third of the samples. The maximum concentration detected was 0.32 ug/L, which is approximately five times the Provincial Water Quality Objective. In addition, MCPP (39%), 2,4-D (31%) and atrazine (8%) were detected.

3.3.4 Wilket Creek

Wilket Creek drains an area of Toronto that is approximately 98% urbanized with middle and upper class neighbourhoods as well as some parkland (e.g., Edward Gardens) which is heavily wooded with mature coniferous and deciduous stands (City of Toronto 2004). The creek feeds into the West Don River. Twenty-eight water samples were taken from Wilket Creek between 1998 and 2001.

Five pesticides and a metabolite were detected in these water samples. The most frequently detected pesticide was diazinon, which was identified in more than half of the samples, followed by MCPP which was found in about one third of the samples. 2,4-D, metolachlor and DEA were also detected, but less frequently. The diazinon PWQO was exceeded in approximately one third of the samples. The CWQG for total phenoxy herbicides of 4 ug/L was exceeded on one occasion.

3.4 Additional Comparisons

3.4.1 Watershed Comparisons

Statistical analysis found that atrazine was significantly detected more frequently and detected at significantly higher concentrations in the Humber River when compared to the Don River ($p = 5.0 \times 10^{-6}$, Figure 5). This difference between watersheds may reflect land usage patterns, as the Humber River watershed has more area under agricultural use compared to the Don River watershed. Conversely, MCPP, which is a common lawn care herbicide, was detected in the Don River at higher concentrations approaching statistical significance ($p = 0.095$) when compared to the Humber River.

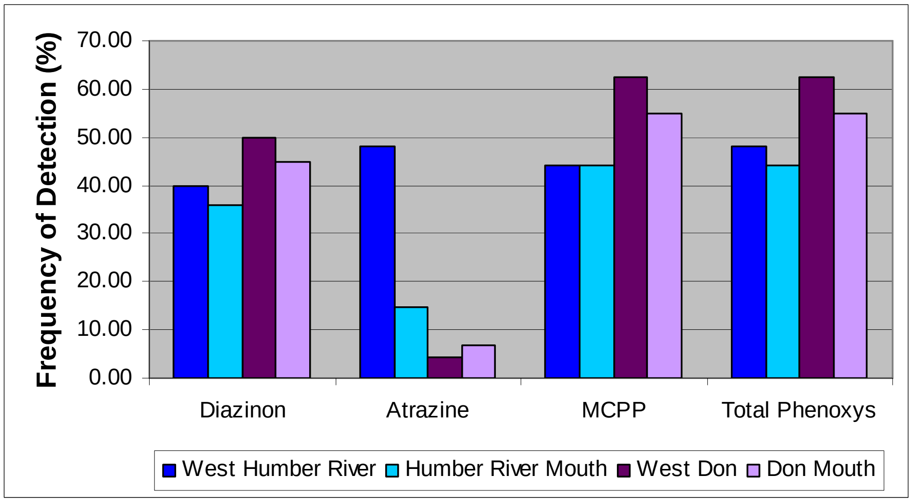

Figure 5: Pesticide Detections - Watershed Comparison.

Neither concentrations of diazinon, MCPP nor total phenoxys were statistically different between the Don River and the Humber River after adjusting for location, year and weather effects.

Statistical analysis showed no discernible differences in frequency of detection and concentrations of pesticides between Burke Brook and Wilket Creek.

3.4.2 Precipitation Effects

Diazinon was the only pesticide which showed a statistical difference in the frequency of detection during wet events compared to dry events ($p = 2.0 \times 10^{-4}$). Diazinon, which is used in both urban and agricultural environments, was more frequently detected during wet events. In the case of atrazine, the frequency of detection did not vary with precipitation. Taken together, these two findings may indicate that urban run-off is likely the primary source of diazinon in the Don and Humber River watersheds. It should be noted that there are other influencing factors contributing to the frequency of detection (e.g. differing physical-chemical properties of the pesticides, the possibility that rainfall patterns are not evenly distributed in the watershed). Further data need to be gathered to determine the contribution of urban run off to diazinon loading in the Don River.

3.4.3 Seasonal Changes

Both atrazine and total phenoxy herbicide concentrations decrease significantly in the latter portion of the year ($p=1.5 \times 10^{-5}$ and $p=0.01$, respectively; i.e. July through September). For atrazine, this likely mirrors the usage pattern as it is generally applied only in the spring. For total phenoxy herbicides, agricultural applications are predominantely in the Spring, although lawn care applications occur from spring through the fall. All other pesticides showed no statistically significant difference.

3.4.4 Differences in Detection Across Sample Years

Figure 6 as well as Tables 9 and 10 show frequency of detections and frequency of water quality criteria exceedences for pesticides by year. There was no statistically significant difference in frequency of detections between years for any pesticide. Figure 6 shows the frequency of detection for selected pesticides by year. Mecoprop, diazinon and 2,4-D were the most frequently detected pesticides. Diazinon was not detected in either the lower Don River or the lower Humber River in 2002. The reason for the lack of detection is unknown, as its usage only began to be restricted in 2002. It is also possible that the influence of precipitation was a factor as 2002 was a drier year than the two preceding years (Environment Canada 2004) and, therefore, there was less run-off.

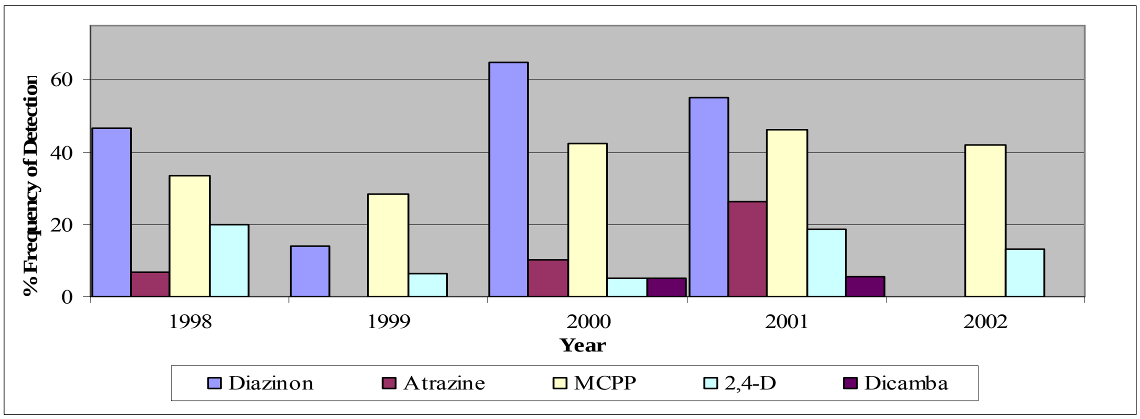

Figure 6: Frequency of Detection for Selected Pesticides by Sampling Year.

Table 9: Summary of Pesticide Detection Frequency by Sampling Year

	DL ug/L	1998 % >DL	1999 % >DL	2000 % >DL	2001 % >DL	2002 % >DL
Diazinon	0.02	46.67	14.10	65.00	54.95	0.00
Cypermethrin	0.05	6.67	0.00	0.00	0.00	0.00
Atrazine	0.02	6.67	0.00	10.00	26.37	0.00
DEA	0.05	13.33	0.00	0.00	0.00	0.00
Metolachlor	0.05	13.33	0.00	2.50	10.99	0.00
MCPP	0.10	33.33	28.21	42.50	46.15	42.11
2,4-D	0.10	20.00	6.41	5.00	18.68	13.16
Carbofuran	0.10	0.00	2.56	0.00	0.00	0.00
Dicamba	0.10	0.00	0.00	5.00	5.49	0.00
Metribuzin	0.05	0.00	0.00	2.50	0.00	0.00
Bromacil	0.10	0.00	0.00	0.00	12.09	0.00
Chlorpyrifos	0.05	0.00	0.00	0.00	1.10	0.00
Total Phenoxy		33.33	32.05	47.50	46.15	42.11

Table 10: Exceedences of Water Quality Criteria (WQC) by Sample Year

	WQC ug/L	1998 % > WQC	1999 % > WQC	2000 % > WQC	2001 % > WQC	2002 % > WQC
Diazinon	0.08	40.00	14.10	40.00	41.76	0.00
Atrazine	1.80	0.00	0.00	0.00	2.20	0.00
Carbofuran	1.80	0.00	1.28	0.00	0.00	0.00
Chlorpyrifos	0.001	0.00	0.00	0.00	1.10	0.00
Total Phenoxy	4.00	0.00	0.00	0.00	1.10	0.00

[a] – Canadian Water Quality Guideline for the Protection of Aquatic Life
[b] – Provincial Water Quality Objective for the Protection of Aquatic Life
- No water quality criteria available

4.0 Discussion

4.1 Pesticides in Urban Watersheds

The results of this study suggest that pesticides (both urban and agricultural related) are conveyed through the Don River and Humber River watersheds to Lake Ontario. Similar findings have been reported in urban streams from various jurisdictions in North America. In the US, various studies have shown that diazinon is one of the most commonly detected insecticides (75 % to 100% of urban water samples) in urban stormwater runoff and dry weather flow (Center for Watershed Protection 2003). The United States Geological Survey has documented widespread pesticide contamination of both surface waters and groundwaters throughout the continental United States (USGS 1999). The report documented that numerous streams were affected by the residential use of pesticides in urban areas. Insecticides were found more often and usually at higher concentrations in urban streams when compared to agricultural streams. Diazinon, carbaryl, chlorpyrifos and malathion were the most frequently detected insecticides. The herbicides most commonly found in urban streams were simazine, 2,4-D, atrazine, metolachlor, prometon, diuron and tebuthiuron, the latter three of which are not registered for use in Canada. Struger et al. (1994) attributed pesticide contamination of streams in the Region of Hamilton-Wentworth as well as two stormwater retention ponds in Guelph to the residential use of pesticides. There were numerous detections of herbicides (e.g., 2,4-D, MCPP and dicamba) and of insecticides (e.g., diazinon and chlorpyrifos) especially during wet events sampling. The City of Ottawa (2003) carried out a recent study similar to this one in three watercourses in Ottawa, Ontario. Forty-eight surface water samples were collected during base flow (dry) and wet events. The most frequently detected pesticides were mecoprop (MCPP), detected in 57% of samples, followed by 2,4-D (35%), dicamba (27%) and diazinon (24%). Overall, the predominant pesticides detected were similar in both studies.

In general, diazinon concentrations were higher in the Don River watershed (which is more urbanized) than in the Humber River watershed. The geometric annualized mean of diazinon concentrations from the lower Don River sampling point was 1.5 to 2.5 times greater than the geometric annualized mean from the lower Humber River sampling station (Table 11). Diazinon was not detected at either station in 2002, thus the mean was calculated using a concentration of 0.5 times the detection limit). In Ontario, diazinon

applied in urban areas would primarily be used for lawn insect control. During the course of this study, Southern Ontario experienced high infestations of European chafer and Chinch bug, both of which are controlled by diazinon. In addition, concentrations of diazinon were often higher in samples taken during precipitation events, suggesting that rainwater run-off is a significant means of input of these pesticides to storm water sewers.

Table 11. Annualized Geometric Mean Diazinon Concentrations (ug/L)

Year	Humber River Mouth	Don River Mouth
1998	0.033	0.057
1999	0.041	0.107
2000	0.085	0.128
2001	0.066	0.111
2002	0.010	0.010

The herbicides that were detected (MCPP, dicamba, and 2,4-D) in this study are commonly used in urban areas for the control of weeds on lawns. A number of agricultural herbicides such as atrazine and metolachlor were also detected at the mouths of these rivers, which suggests that agricultural inputs may affect surface water quality far downstream from where they were applied.

Both the Don and Humber Rivers, along with other rivers in the Greater Toronto Area, empty into Lake Ontario resulting in a net input of pesticides to the lake. In a monitoring survey of in-use pesticides in the surface waters of the Great Lakes (Struger et al. 2004), pesticides were either not detected, or were present at extremely low concentrations. For example, diazinon was not detected in the open waters of Lake Ontario, dicamba was detected in only half the samples with the highest concentration being 0.007 ug/L, and 2,4-D was detected in all samples, but with concentrations ranging from 0.0023 to 0.145 ug/L. Analyses were conducted using large volume water samples and very sensitive detection limits. These results are orders of magnitude lower than what was measured in our study suggesting that there is a large dilutive effect once these tributaries enter Lake Ontario.

4.2 Potential Impacts on Aquatic Life

Water quality criteria (CCME Canadian Water Quality Guidelines or Ontario Provincial Water Quality Objectives) were exceeded for four pesticides. With the exception of diazinon, these exceedences were infrequent. For the other three pesticides (atrazine, carbofuran, and chlorpyrifos) exceedence of a water quality criteria occurred in less than 1% of the samples. This would suggest that occurrence of the latter pesticides are unlikely to have an impact on the health of aquatic organisms.

In approximately 30% of the samples collected in this study, diazinon concentrations exceeded the Ontario Provincial Water Quality Objective for the Protection of Aquatic Life which was established to protect the health of aquatic organisms such as fish and invertebrates (0.08 ug/L, OMOE 1994). In one instance, this value was exceeded by more than tenfold. These objectives are developed to protect the most sensitive aquatic organisms to an indefinite exposure to a chemical and safety factors have been incorporated.

Brief exposures of pesticides exceeding water quality objectives, which may be expected during rainfall events or other pulse exposures, would pose less of a risk to the health of aquatic organisms than would a continuous long-term exposure to concentrations exceeding the objectives. Therefore, the impact of these fluctuating diazinon concentrations (ND to 1.0 ug/L) on aquatic ecosystem health is difficult to determine. A study of urban creeks in California found concentrations of diazinon ranging from 0.26 to 1.0 ug/L (Bailey et al., 2000). Creek water was found to be lethal to water fleas (*Ceriodaphnia dubia*) in laboratory tests. The authors performed a Toxicity Identification Evaluation (TIE) and determined that diazinon was the cause of the toxicity. The authors suggest that since *Ceriodaphnia* can be considered as a surrogate for important organisms at the bottom of the food web, there may be an ecological impact at concentrations observed in the waterway. On the other hand, Giddings et al. (2000) reported that the lowest concentration of diazinon to cause an adverse ecological effect in microcosm studies (small scale experimental ecosystems) was 8.4 ug/L. The highest concentrations found in our study were almost ten times lower than the value reported by Giddings et al. (2000).

Solomon (unpublished, Figure 7) performed a probabilistic risk assessment using the results of the 1998 through 2002 data from this study and toxicity data obtained through the literature (Menconi and Cox 1994, Giddings et al. 2000) using published methods (Solomon et al. 2000, Solomon and Takacs 2002). He determined that there may be some risk of acute toxicity to arthropods (e.g. *Daphnia*), but there was negligible direct risk to aquatic vertebrates exposed to diazinon at concentrations detected in the surface waters in the Don and Humber River watersheds (based on how the curves overlap, see Figure 7). He noted that the risks from exposure concentrations in surface waters in the current study were similar to those observed in large rivers in California (e.g., Sacramento and San Joaquin) but smaller than those calculated for smaller creeks and drains in California (Giddings et al. 2000).

On many occasions in this study two or three pesticides were detected in the same sample. The significance of multiple pesticide exposure on aquatic ecosystems is poorly understood and is an area that warrants further investigation. For example, in this study we summed the total concentration of detected phenoxy herbicides to compare to a CWQG for total phenoxy herbicides, as it is known that they all have the same toxicological mode of action. Although each individual phenoxy herbicide never exceeded their individual water quality criterion, the sum of total phenoxy herbicides did exceed the CWQG on one occasion. A method to assess the cumulative impact of a mixture of pesticides to aquatic organisms has not been developed. While each pesticide detected may have met their water quality criterion, it is possible that a number of pesticides, each just below their water quality criterion, could cumulatively impact aquatic organism health. In addition, both the Don and the Humber rivers contain other pollutants (e.g., metals, nutrients, road salt, etc.), which all may affect ecosystem health therefore measuring an actual improvement in ecosystem health due to pesticide reduction would be difficult.

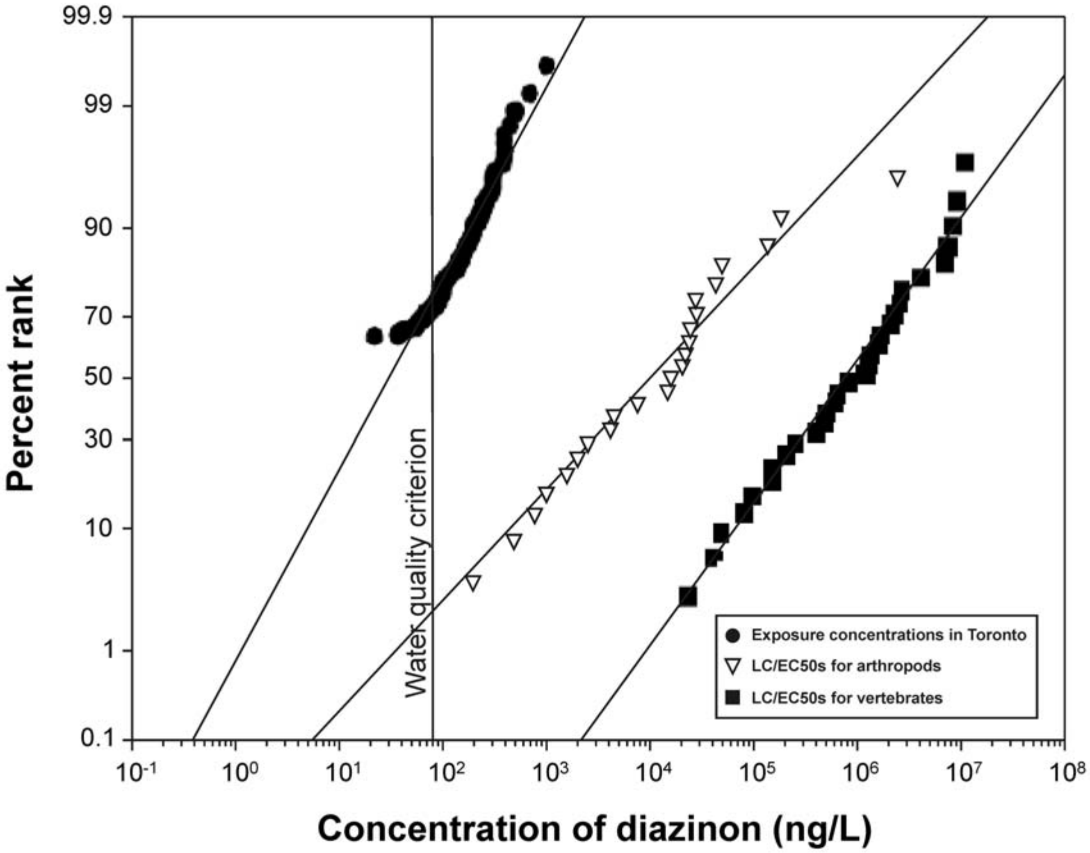

Figure 7: Distribution of Exposure Concentrations for Diazinon in the Don and Humber River Watersheds (From Solomon Unpublished).

While only one metabolite was detected in this study (DEA), and only eight metabolites were analyzed for in total, there are many other pesticide degradation products that could be analyzed for in surface water. While metabolites are usually less toxic than the parent compound, some may be of potential toxicological concern and worth investigating.

4.3 Reduction of Pesticide Inputs to Watersheds

4.3.1 Regulatory Changes

The pesticide found most often to be in exceedence of water quality criteria was diazinon. In December 2000, the Pest Management Regulatory Agency (PMRA) of Health Canada, which is responsible for registering pesticides for sale and use in Canada, announced the result of their re-evaluation of domestic/urban uses of diazinon products (See PMRA Re-evaluation Note REV2000-08) as part of a larger program on the re-evaluation of all major urban lawncare pesticides. The PMRA has decided to restrict the domestic uses of diazinon and, with the agreement of the Canadian registrants, phase-out residential turf uses of diazinon. The amount of diazinon available for sale was reduced by 25% in 2002 and by 50% in 2003. Indoor use products were no longer available after 2002. Outdoor use products for homeowners were taken off the market at the end of 2003, while commercial lawncare product sales ended after 2004. Use of the products was allowed

for one year after the end of sales. Thus, 2006 was the first year where there was no diazinon use in urban lawncare.

The results of our study have been provided to the PMRA for their re-evaluation of lawn care pesticides. As the urban use of diazinon decreases, it is expected that its concentrations in surface waters would also decrease.

There are few registered pesticides to replace diazinon for the control of urban turf insects. Residential use of the other commonly used turf insecticide, chlorpyrifos (Dursban), ended as of December, 2001. Imidacloprid (Merit ®) was recently introduced for the control of certain turf insects (as well as other agricultural uses), but must only be applied by professional applicators (i.e., not by homeowners), and at certain times of the year. It is reasonable to expect that as the use of diazinon and chlorpyrifos decline, there will be an increase in the use of imidacloprid, possibly resulting in its detection in urban waterways. Samples taken in 2000 and 2001 were analyzed for imidacloprid, but it was not detected. However, the detection limit for imidacloprid (1 ug/L) was relatively high compared to most of the pesticides analyzed for in this study. Further development of the analytical method for imidacloprid is warranted to improve the detection limit. Phillips and Bode (2002), for example, reported that imidacloprid was detected in streams receiving urban run-off in south-eastern New York state in the summer of 2000, with concentrations exceeding 0.1 ug/L. A later study of the same area reported detecting imidacloprid in 40% of samples, with 4% of samples containing imidacloprid at a concentration greater than 0.1 ug/L (Phillips and Bode 2004). However, it should be noted that lawn care pesticides containing imidacloprid are available for home owner use in the United States and, therefore, may be used in greater quantity than in Ontario.

Bromacil was also detected in a number of samples in this study, but exclusively in the Don River watershed and primarily in the West Don River. The PMRA has recently released its re-evaluation of Bromacil (PMRA 2004) and is proposing a number of label changes, including that the product not be used in residential areas (i.e., homes, parks, school grounds, and around public buildings, etc.), and that a 65 metre buffer zone be left between the point of application and sensitive aquatic habitats (lakes, rivers, creeks, etc.). Proposed changes to the use of bromacil should lead to lower detections in surface water systems.

The City of Toronto recently passed a municipal by-law that restricts the use of pesticides by both homeowners and professional applicators for cosmetic purposes except under circumstances of infestations. The by-law came into effect in April 2004 and enforcement of the by-law was phased-in from 2005 to 2007 (L. Vanderlinden, pers comm.). Other Ontario municipalities are considering similar by-laws.

4.3.2 Applicator Practices

Hoffman et al. (2000) suggest that most pesticide inputs to urban surface waters are a result of run-off from impermeable surfaces such as parking lots, sidewalks, driveways and patios to which they have been deposited by spray drift and aerial or misdirected application. They suggest very little run-off of pesticides occurs from well-maintained grass, even during heavy rain. Encouraging professional applicators and homeowners to

use more caution when applying pesticides on to turf to avoid misdirected application may help reduce the amount of pesticides entering urban waterways.

In addition, reducing the reliance on urban pesticide use, through the promotion of Integrated Pest Management (IPM) may lead to improved water quality. IPM is a decision making process which uses a variety of techniques, including cultural, mechanical and biological, along with pesticides, to suppress pest populations. An IPM approach emphasizes pest prevention and includes pest identification and monitoring and the use of appropriate pest management methods. In an IPM program, treatments are only applied when needed, based on monitoring of the pest populations, in contrast to regularly scheduled applications or "calendar" sprays (Adams and Gilkeson 1999). The Ontario lawn care industry has recently initiated an IPM accreditation program, developed by the IPM-PHC Council of Ontario (see www.ontarioipm.com).

5.0 Conclusions

In conclusion, and with reference to the objectives of this study:

1. To determine concentrations of pesticides in surface waters of the Don and Humber Rivers and some of their tributaries
    - In this study, a total of 262 surface water samples were collected. Of the 152 pesticides and 8 metabolites that were monitored, eleven pesticides and one metabolite were detected. These compounds were: 2,4-D, atrazine, bromacil, carbofuran, chlorpyrifos, cypermethrin, diazinon, dicamba, MCPP, metolachlor, metribuzin, and an atrazine metabolite, des-ethyl atrazine (DEA).
    - Approximately 75% of samples contained at least one pesticide at a detectable concentration.
2. To determine whether urban inputs of pesticides from within the City of Toronto could be distinguished from agricultural and other pesticide inputs upstream of the City by comparison of upstream and downstream pesticide concentrations
    - Atrazine concentrations were statistically higher upstream in the Humber River compared to downstream samples. Other pesticides (including other agricultural pesticides) did not show a statistical difference between upstream and downstream locations.
    - There was no statistical difference between upstream and downstream locations on the Don River for any pesticides.
    - Aside from atrazine in the Humber River, this study could not statistically distinguish between urban and agricultural pesticide inputs to the watersheds.
    - Approximately 72% of samples contained at least one pesticide attributable to lawn care use (i.e. diazinon, chlorpyrifos or phenoxy acid herbicide) at a detectable concentration.

3. To determine possible spatial and temporal trends in concentrations
    - Atrazine was more frequently detected and was detected at higher concentrations in the Humber River compared to the Don River.
    - MCPP was detected in the Don River at higher concentrations than in the Humber River

- There was no significant difference in frequency of detection or in concentrations of other pesticides between the two rivers.
    - There was no significant difference in frequency of detection or in concentrations of other pesticides between the two small creeks sampled in this study (Burke Brook and Wilket Creek).
    - Atrazine and total phenoxy herbicide concentrations significantly decreased in the latter portion of the year (July through December), other pesticides showed no difference.
    - There was no significant difference in frequency of detections between sample years for any pesticide.
4. To identify possible environmental concerns by comparing ambient concentrations to available federal and provincial water quality criteria
    - Only diazinon regularly exceeded the Provincial Water Quality Objective for the Protection of Aquatic Life (27.5%).
    - Other pesticides either did not exceed, or rarely exceeded (< 1%), their water quality criteria.
5. To investigate whether golf course turf care contributed to pesticide concentrations at one location on the Humber River
    - The golf course did not significantly influence the frequency of detections or concentrations of pesticides within the golf course or entering the Humber River
    - The frequency of detection of pesticides was overall lower at golf course sampling locations compared to other locations

Overall, the results of this study suggest that pesticides used in agriculture and on lawns in urban areas are being transported to the Don and Humber River watersheds and ultimately to Lake Ontario. The pesticides diazinon, 2,4-D, MCPP, atrazine and metolachlor were frequently detected in this study. The presence of pesticides in water is influenced by many factors such as their persistence in the environment, their mobility, and their volume of use. For example, Phillips and Bode (2004) conclude that the physical characteristics of the watersheds, including soil types, extent of paved areas, and presence of wetlands and storm-water detention ponds, as well as storm characteristics will influence the occurrence of pesticides in urban streams. These factors would contribute to the differences in frequency and magnitude of the detection of pesticides in this study and make it difficult to accurately assess the impacts of land use on surface water quality.

In a number of instances, agricultural pesticides were detected at stations that we considered to have only urban inputs (e.g. carbofuran at the golf course). Since the focus of this study was not meant to "track down" pesticide sources, the cause of these pesticide inputs could not be determined. In the future, it may be worth pursuing the identification of these anomalous pesticide detections.

This study compared pesticide concentration data, and this may be a factor in why we were unable to show a statistical difference for many of the relationships tested. There is a significant difference in flow between the upstream and downstream sites. Future studies might consider using a loadings comparison instead of concentrations. Accurate

flow measurements at the sampling location would be required, which were unavailable for this study.

Future monitoring activities should target new pesticides replacing those being currently phased out for urban lawn insect control (e.g. diazinon, chlorpyrifos). In addition, there is a need to develop analytical methods for detecting low concentrations of pesticide metabolites and degradation products. A more detailed ecological risk assessment should be considered to evaluate the possible effects of pesticides (such as diazinon) on these waterbodies.

6.0 Acknowledgments

This project would not have been successful without the diligent efforts of Bruce Quick, Danilo Roberto, Wojtek Goral and Monica Middleton of the Industrial Waste and Stormwater Quality Unit, Works and Emergency Services Department, City of Toronto. Their efforts to conduct the field monitoring portion of this project are greatly appreciated. Appreciation is also extended to Danilo Roberto, of the City of Toronto, for producing the hydrographs of the wet weather events and also the Water Survey of Canada for provision of the Humber and Don River flow data.

Some sampling of the Don and Humber River mouths was done to support the MOE's Provincial Water Quality Monitoring Network. We would like t`o thank Aaron Todd for graciously providing us with the pesticides data from the Network, as well as Jim Eddy who sampled these locations.

We would also like to acknowledge the fine work done by Pam Brown, University of Guelph Laboratory Services, in co-ordinating and preparing the analytical reports. We would like to thank Perry Martos and Brian Ripley who co-ordinated the laboratory analysis of this project and provided numerous useful comments on previous drafts. The map of Toronto with sampling stations was created by John Kraft of Environment Canada.

We would like to express our appreciation to the peer reviewers of our 2002 interim report, Dr. Monica Campbell (City of Toronto Public Health Department), Dr. Keith Solomon (Centre for Toxicology, University of Guelph) and Ms. Janice Villeneuve (Pest Management Regulatory Agency, Health Canada).

We would like to thank the following for providing helpful comments on drafting this final report:

Lorna Poff (OMOE, Standards Development Branch)
Paul Helm (OMOE, Environmental Monitoring and Reporting Branch)
Stephan Maude (OMOE, Water Policy Branch)
Don Williams (EC, Ecosystem Health Division)
Wanda Michalowicz (OMOE, Standards Development Branch)
Sarah Bowerman (OMOE, Standards Development Branch)
Monica Nowierski (OMOE, Standards Development Branch)

Finally, we would like to thank the peer reviewers of this final report, Dr. Loren Vanderlinden (City of Toronto, Public Health Department), Dr. Keith Solomon (Centre for Toxicology, University of Guelph), Ms. Janice Villeneuve (Pest Management Regulatory Agency, Health Canada) and members from the Ontario Pesticide Advisory Committee (Dr. Gerry Stephenson, Mr. Bruce McGauley, Mr. Hugh Berges, and Ms. Ivy Wile).

Recognizing that scientists may have conflicting scientific opinions, the authors used their discretion in addressing comments submitted by peer reviewers.

7.0 Literature Cited

Adams, R.W. and L.A. Gilkeson. 1999. Integrated Pest Management Manual for Homes and Garden Pests in B.C. British Columbia Ministry of Lands and Parks.

APHA (American Public Health Association). 1998. Standard Methods for the Examination of Water and Wastewater. 20th Edition. Washington, DC.

Bailey, H.C., L. Deanovic, E. Reyes, T. Kimball, K. Larson, K. Cortwright, V. Connor, and D. E. Hinton. 2000. Diazinon and chlorpyrifos in urban waterways in northern California, USA. Environ. Tox. Chem. 19(1): 82-87.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life. *In* Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg.

CHRS (Canadian Heritage River Systems). 2001. http.//www.chrs.ca

City of Waterloo. Unpublished. Pesticide Use/Concerns Poll. A Public Opinion Poll of Residents of the City of Waterloo. Prepared for City of Waterloo Citizens Environmental Advisory Committee. Prepared by Metroline Research Group Inc. February, 2000.

CMCS (Canadian Manufacturers of Chemical Specialties Association). Unpublished. Canadian Consumer Data 2000-2001. Source of Data - Ipsos Reid and AC Nielsen. CMCS. Ottawa, Ontario.

Center for Watershed Protection. 2003. Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Elliot City, MD. 142p.

City of Ottawa. 2003. 2003 Surface Water Pesticide Monitoring Program Summary Report. City of Ottawa. Water Environment Protection Program. Transportation Utilities and Public Works. 26p.

City of Toronto. 2004. Discover Walks. Northern Ravines and Gardens. Toronto, ON. 2p.

Environment Canada 2004. On-line precipitation data. Water Survey of Canada. http://www.psitech.pyr.ec.gc.ca/waterweb

EXTOXNET. 2004. The Extension Toxicology Network. Oregon State University. Corvallis, OR. http://extoxnet.orst.edu/

Giddings, J.M., L.W.J. Hall, and K.R. Solomon. 2000. An ecological risk assessment of diazinon from agricultural use in the Sacramento-San Joaquin River basins, California. Risk Analysis 20:545-572.

Goolsby, D.A., E.M. Thurman, M.L. Pomes, M.T. Meyer and W.A. Battaglin. 1997. Herbicides and their metabolites in rainfall: origin, transport, and deposition patterns across the Midwestern and northeastern United States, 1990-1991. Environ. Sci. Technol. 31(5):1325-1333.

Hall, J.C., T.D. Van Deynze, J. Struger, and C.H. Chan. 1993. Enzyme immunoassay based survey of precipitation and surface water for the presence of atrazine, metolachlor and 2,4-D. J. of Environ. Sci. and Health Part B – Pesticides, Food Contaminants, and Agricultural Wastes, vol. B28(5).

Hoffman, R.S., P.D. Capel, and S. J. Larson. 2000. Comparison of pesticides in eight U.S. urban streams. Environ. Tox. Chem. 19(9):2249-2258.

Insightful Corp. 2002. S-Plus Professional V6.1 Statistical Software. Seattle, Washington. www.insightful.com

Kuang, Z., L.L. McConnell, A. Torrents, D. Merritt, and S. Tobash. 2003. Atmospheric Deposition of Pesticides to an agricultural watershed of the Chesapeake Bay. J. Environ. Qual. 32:1611-1622.

Mackay, D., W.K. Shiu and K.C. Ma. 2000. Physical-Chemical Properties and Environmental Fate Handbook. CRCnetBase 2000. Chapman and Hall/CRCnetBase.

Menconi, M and C. Cox. 1994. Hazard Assessment of the Insecticide Diazinon to Aquatic Organisms in the Sacramento-San Joaquin River System. Rancho Cordova, CA. California Department of Fish and Game. Administrative Report. Report No. 94-2.

McConnell, L.L., E. Nelson, C.P. Rice, J.E. Baker, W.E. Johnson, J.A. Harman, and K. Bialek. 1997. Chlorpyrifos in the air and surface water of Chesapeake Bay: Predictions of atmospheric deposition fluxes. Environ. Sci. and Technol. 31:1390-1398.

McConnell, L.L., J.S. LeNoir, S. Datta, and J.N. Seiber. 1998. Wet deposition of current-use pesticides in the Sierra Nevada mountain range, California, USA. Environ. Tox. Chem. 17:1908-1916.

McCullagh, P. and J.A. Nelder. 1994. Generalized Linear Models. Chapman and Hall, New York.

OMOE (Ontario Ministry of the Environment). 1994. Water Management: Goals, policies and implementation procedures of the Ministry of the Environment. Toronto, Ontario.

OMAFRA (Ontario Ministry of Agriculture, Food and Rural Affairs). 1994. Survey of Pesticide Use in Ontario 1993. Economics and Policy Co-ordination Branch, OMAFRA. Guelph, Ontario.

PMRA (Pest Management Regulatory Agency), 2004. PACR2004-22. Re-evaluation of Bromacil. Health Canada. Ottawa, ON.

PMRA (Pest Management Regulatory Agency). 2000. REV2000-08. Update on Re-evaluation of Diazinon in Canada. Health Canada. Ottawa, Ontario.

Phillips, P.J. and R.W. Bode. 2004. Pesticides in surface water runoff in south-eastern New York State, USA: seasonal and stormflow effects on concentrations. Pest. Manag. Sci. 60:531-543.

Phillips, P.J. and R.W. Bode. 2002. Concentrations of pesticides and pesticide degredates in the Croton River watersheds in south-eastern New York, July-September 2000. US Geological Survey Water-Resources Investigations Report 02-4063. Troy, New York. http://ny.water.usgs.gov/pubs/wri/wri024063/.

RAIS (Risk Assessment Information System). 2004. . Oak Ridges National Laboratory. Oak Ridges, TN. http://risk.lsd.ornl.gov/index.shtml

Solomon, K.R., J.P Giesy and P. Jones. 2000. Probabilistic risk assessment of agrochemicals in the environment. *Crop Protection* 19:649-655.

Solomon KR, and P. Takacs. 2002. Probabilistic risk assessment using species sensitivity distributions. In: Posthuma L, T. Traas and G.W. Suter. eds. *Species Sensitivity Distributions in Risk Assessment*. Boca Raton, FL, USA: CRC Press. p 285-313.

Struger, J., S. L'Italien and E. Sverko. 2004. In-use pesticide concentrations in surface waters of the Canadian Great Lakes, 1994-2000. J. Great Lakes Res. 30(3):435-450.

Struger, J., D. Boyter, Z.J. Licsko, and B.D. Johnson. 1994. Environmental concentrations of urban pesticides. *In* James, W. (ed.) *Current Practices in Modeling the Management of Stormwater Impacts*. CRC Press, Boca Raton, Fl. Pp. 85-98.

TPHD (Toronto Public Health Department). 2002. A Survey of Toronto Residents' Awareness, Uses and Attitudes Towards Pesticides. Health Promotion and Environmental Protection Office, City of Toronto, Toronto, Ontario.

TRCA (Toronto and Region Conservation Authority). 2003. A Summary of Water Quality Data in the Toronto Region from 1996 to 2002. TRCA. Toronto, ON. 22p.

USEPA (United States Environmental Protection Agency). 1997. Guidelines establishing test procedures for the analysis of pollutants (App. B, Part 136, Definition and procedures for the determination of the method detection limit): U.S. Code of Federal Regulations, Title 40, revised July 1, 1997, p. 265–267.

United States Geological Survey. 1999. The Quality of Our Nation's Waters-Nutrients and Pesticides. U.S. Geological Survey Circular 1225. 82p.

Zajdlik and Associates, Inc. Unpublished. Testing Hypotheses Regarding Pesticides in the Don and Humber Rivers. Prepared for the Ontario Ministry of Environment. Prepared by Zajdlik & Associates, Inc. Rockwood, ON. 27p.

8.0 Pesticide and Pesticide Metabolite Analytical List

2,4-D	Dichlofluanid	metolachlor	Terbacil
2,4-DB	dichloran	metribuzin	Terbufos
2,4-DP	dichlorvos	mevinphos(cis)	Terbutyrn
Alachlor	dicrotophos	mevinphos(trans)	Terbutylazine
Ametryn	*dimethoate*	monocrotophos	Tetrachlovinphos
atrazine	dinitramine	myclobutanil	Tolyfluanid
azinphos-ethyl	dioxathion	nitralin	Triadimefon
azinphos-methyl	diphenamid	nitrofen	Triallate
Benfluralin	diphenylamine	oxycarboxin	Trifluralin
Bromacil	disulfoton	parathion	Vernolate
Bromophos	*dithiopyr*	parathion-methyl	Vinclozlin
Bromophos-ethyl	EPN	paroxon	Aldrin
Butylyate	EPTC	PCP	alpha,beta, and delta BHC
Carbofuran	ethalfluralin	pebulate	Captafol
carbophenothion	ethion	pendimethalin	Captan
Carboxin	ethoprop	phorate	Chlorbenside
chlorfenvinphos(cis)	etridiazole	phosalone	cis and trans chlordane
chlorfenvinphos(trans)	etrimfos	phosmet	Chlorthal-dimethyl
Chlormephos	fenamiphos	phosphamidon	Chlorothalonil
chlorobromuron	Fenchlorphos	pirimicarb	Cypermethrin
Chlorpyrifos[1]	fenitrothion	pirimiphos-ethyl	DDT-o,p' and DDT-p,p'
chlorpyrifos-methyl	fensulfothion	pirimiphos-methyl	deltamethrin
Chlorpropham	fenthion	procymidone	Dicofol
Clomazone	fonofos	profenofos	endosulfan sulphate
Coumaphos	*glyphosate*	prometyrn	endosulfan-I and II
Crotoxyphos	hexazinone	prometon	Folpet
Crufomate	*imidacloprid*	propanil	Heptachlor and H. epoxide
Cyanazine	iodophenphos	propargite	Lindane
Cyanophos	iprodione	propazine	Mirex
Cycloate	isofenphos	propiconazole	cis and trans permethrin
Cyprazine	leptophos	*propoxur*	quintozene
dementon-O	*malathion*	propyzamide	**Metabolites**
dementon-S	MCPA	pyrazophos	dimethoate-oxon
diallate-1	MCPB	quinalophos	DDD-o,p' and DDD-p,p'
diallate-2	*MCPP(mecoprop)*	ridomil	DDE-o,p' and DDE-p,p'
Diazinon[1]	methidathion	simazine	des-ethyl atrazine
Dicamba	methoprotryn	sulfotep	AMPA (glyphosate)
Dichlobenil	Methyl trithion	tebuthiuron	Desmethyl pirimicarb

Italicized pesticides are those commonly used for urban lawn care
Lighter coloured pesticides are not registered for use in Canada
[1]Lawn care uses being removed from label

Registration data from PRMA EDDENET ELSE Label Search (http://www.eddenet.pmra-arla.gc.ca/4.0/4.01.asp). If product was not found, it was assumed that it was not registered.

LOCATION: WEST HUMBER RIVER

Legend		
DL - Detection Limit	NA - Not Analyzed For	CYP - Cypermethrin
WQC - Water Quality Criteria	ND - Not Detected	SIM - Simazine
	MDL - Detected but not Quantifiable	DATR - des ethyl atrazine

Date	Imidacloprid	Glyphosate	Dithiopyr	Diazinon	Chlorpyrifos	CYP	SIM	Atrazine	DATR	Metribuzin	Carbofuran	Metolachlor	Bromacil	Dicamba	MCPP	2,4-D	MCPA	2,4-DB	Total Phen.	*Weather*
DL (ug/L) >	**1**	**50**	**10**	**0.02**	**0.05**	**0.05**	**0.05**	**0.02**	**0.02**	**0.05**	**0.1**	**0.05**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	
WQC (ug/L) >	**-**	**65**	**-**	**0.08**	**0.001**	**-**	**10**	**1.8**	**1.8**	**1**	**1.8**	**7.8**	**-**	**4**	**4**	**4**	**4**	**4**	**4**	
1999/07/31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/08/04	ND	ND	ND	0.40	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	0.05	*Wet*
1999/08/18	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.90	ND	ND	ND	0.95	*Dry*
1999/09/28	ND	ND	ND	ND	ND	ND	MDL	MDL	ND	ND	MDL	MDL	ND	MDL	1.00	0.80	ND	ND	1.85	*Dry*
1999/09/29	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/09/30	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	MDL	ND	ND	ND	0.05	*Wet*
1999/10/21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/11/02	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/11/03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.80	ND	ND	ND	0.85	*Wet*
2000/08/31	ND	ND	ND	0.04	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	0.35	ND	ND	ND	0.35	*Dry*
2000/09/23	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.31	ND	ND	ND	0.31	*Wet*
2000/09/27	ND	ND	ND	0.13	ND	ND	ND	MDL	ND	ND	ND	ND	ND	0.27	ND	ND	ND	ND	0.27	*Dry*
2000/11/02	ND	ND	ND	0.01	ND	ND	ND	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/05/22	ND	ND	ND	0.17	ND	ND	ND	0.13	ND	ND	ND	0.08	ND	ND	0.65	ND	ND	ND	0.65	*Wet*
2001/06/08	ND	ND	ND	ND	ND	ND	ND	3.60	ND	ND	ND	1.60	ND	2.20	0.60	ND	ND	ND	2.80	*Dry*
2001/06/11	ND	ND	ND	ND	ND	ND	ND	2.10	ND	ND	ND	1.00	ND	1.60	0.50	ND	ND	ND	2.10	*Wet*
2001/07/17	ND	ND	ND	MDL	ND	ND	ND	0.52	ND	ND	ND	0.18	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/08/01	ND	ND	ND	0.23	ND	ND	ND	0.59	ND	ND	ND	0.13	ND	MDL	0.50	ND	ND	ND	0.55	*Dry*
2001/08/01	ND	ND	ND	0.27	ND	ND	ND	0.70	ND	ND	ND	0.18	ND	MDL	0.55	ND	ND	ND	0.60	*Dry*
2001/08/17	ND	ND	ND	0.07	ND	ND	ND	0.66	ND	ND	ND	0.13	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/20	ND	ND	ND	MDL	ND	ND	ND	0.13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/09/11	ND	ND	ND	ND	ND	ND	ND	0.68	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/09/20	ND	ND	ND	0.09	ND	ND	ND	0.37	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/09/25	ND	ND	ND	0.07	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	1.10	ND	ND	ND	1.10	*Wet*
2001/10/12	ND	ND	ND	MDL	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*

LOCATION: HUMBER RIVER MOUTH

Legend		
DL - Detection Limit	NA - Not Analyzed For	CYP - Cypermethrin
WQC - Water Quality Criteria	ND - Not Detected	SIM - Simazine
	MDL - Detected but not Quantifiable	DATR - des ethyl atrazine

Date	Imidacloprid	Glyphosate	Dithiopyr	Diazinon	Chlorpyrifos	CYP	SIM	Atrazine	DATR	Metribuzin	Carbofuran	Metolachlor	Bromacil	Dicamba	MCPP	2,4-D	MCPA	2,4-DB	Total Phen.	*Weather*
DL (ug/L) >	**1**	**50**	**10**	**0.02**	**0.05**	**0.05**	**0.05**	**0.02**	**0.02**	**0.05**	**0.1**	**0.05**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	
WQC (ug/L) >	**-**	**65**	**-**	**0.08**	**0.001**	**-**	**10**	**1.8**	**1.8**	**1**	**1.8**	**7.8**	**-**	**4**	**4**	**4**	**4**	**4**	**4**	
1998/06/09	NA	NA	NA	0.01	ND	ND	ND	1.10	1.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1998/06/25	NA	NA	NA	0.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.60	ND	ND	ND	0.60	*Wet*
1998/06/30	NA	NA	NA	0.14	ND	ND	ND	ND	ND	ND	ND	1.60	ND	ND	0.94	1.00	ND	ND	1.94	*Wet*
1998/09/14	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/03/31	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/05/05	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/05/19	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	1.70	1.40	ND	ND	3.15	*Wet*
1999/06/01	NA	NA	NA	0.40	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.60	ND	ND	ND	0.65	*Wet*
1999/07/13	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/07/31	NA	NA	NA	MDL	MDL	ND	ND	ND	ND	ND	MDL	ND	ND	MDL	1.00	1.00	ND	ND	2.05	*Wet*
1999/08/04	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	MDL	ND	ND	ND	0.10	*Wet*
1999/08/18	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/09/09	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/09/28	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.80	ND	ND	ND	0.80	*Dry*
1999/09/29	NA	NA	NA	0.30	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/09/30	NA	NA	NA	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/10/21	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/11/02	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	1.00	ND	ND	ND	MDL	ND	ND	ND	0.05	*Wet*
1999/11/03	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.90	ND	ND	ND	0.95	*Wet*
2000/07/18	ND	ND	ND	0.01	ND	ND	ND	0.45	ND	0.12	ND	0.51	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/08/13	ND	ND	ND	0.07	ND	ND	ND	0.05	ND	ND	ND	ND	ND	ND	0.13	ND	ND	ND	0.13	*Dry*
2000/09/08	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/09/23	ND	ND	ND	0.22	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.36	ND	ND	ND	0.41	*Wet*
2000/10/08	ND	ND	ND	0.09	ND	ND	ND	MDL	ND	ND	ND	ND	ND	MDL	0.34	0.14	ND	ND	0.53	*Dry*
2000/11/07	ND	ND	ND	0.17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/11/10	ND	ND	ND	0.18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.63	ND	ND	ND	0.63	*Wet*
2000/12/07	ND	ND	ND	0.15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/04/26	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/05/22	ND	ND	ND	0.15	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.65	ND	ND	ND	0.70	*Wet*
2001/05/22	ND	ND	ND	0.16	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	1.20	1.20	ND	ND	2.40	*Wet*
2001/05/28	ND	ND	ND	0.01	ND	ND	ND	0.83	ND	ND	ND	0.55	ND	0.60	0.80	ND	ND	ND	1.40	*Wet*
2001/06/08	ND	ND	ND	0.01	ND	ND	ND	0.57	ND	ND	ND	0.29	ND	0.50	0.65	ND	ND	ND	1.15	*Dry*
2001/06/11	ND	ND	ND	0.13	ND	ND	ND	0.25	ND	ND	ND	ND	ND	ND	0.90	1.20	ND	ND	2.10	*Wet*
2001/06/11	ND	ND	ND	0.44	ND	ND	ND	0.29	ND	ND	ND	0.20	ND	MDL	0.90	ND	ND	ND	0.95	*Wet*
2001/07/17	ND	ND	ND	0.10	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/08/01	ND	ND	ND	MDL	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/17	ND	ND	ND	0.15	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	1.30	ND	ND	ND	1.30	*Dry*
2001/08/20	ND	ND	ND	0.16	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	0.90	ND	ND	ND	0.90	*Wet*
2001/09/11	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/09/20	ND	ND	ND	0.23	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	0.95	ND	ND	ND	0.95	*Wet*
2001/09/25	ND	ND	ND	0.06	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/10/12	ND	ND	ND	0.07	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2002/02/26	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2002/05/09	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2002/05/13	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.05	*Wet*
2002/05/27	NA	NA	NA	0.01	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.10	*Dry*
2002/06/03	NA	NA	NA	0.01	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.10	*Dry*
2002/06/17	NA	NA	NA	0.01	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2002/06/27	NA	NA	NA	0.01	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.10	*Dry*
2002/07/08	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2002/07/31	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.05	*Dry*
2002/08/15	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.10	*Dry*
2002/08/28	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2002/09/16	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.62	ND	ND	ND	0.62	*Dry*
2002/09/26	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.16	ND	ND	ND	0.16	*Dry*

LOCATION: HUMBER RIVER MOUTH

Legend		
DL - Detection Limit	NA - Not Analyzed For	CYP - Cypermethrin
WQC - Water Quality Criteria	ND - Not Detected	SIM - Simazine
	MDL - Detected but not Quantifiable	DATR - des ethyl atrazine

Date	Imidacloprid	Glyphosate	Dithiopyr	Diazinon	Chlorpyrifos	CYP	SIM	Atrazine	DATR	Metribuzin	Carbofuran	Metolachlor	Bromacil	Dicamba	MCPP	2,4-D	MCPA	2,4-DB	Total Phen.	*Weather*
DL (ug/L) >	**1**	**50**	**10**	**0.02**	**0.05**	**0.05**	**0.05**	**0.02**	**0.02**	**0.05**	**0.1**	**0.05**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	
WQC (ug/L) >	**-**	**65**	**-**	**0.08**	**0.001**	**-**	**10**	**1.8**	**1.8**	**1**	**1.8**	**7.8**	**-**	**4**	**4**	**4**	**4**	**4**	**4**	
2002/10/07	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.20	ND	ND	ND	0.20	*Dry*
2002/10/22	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.20	ND	ND	ND	0.20	*Wet*
2002/11/06	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.11	ND	ND	ND	0.36	*Wet*
2002/11/12	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.47	ND	ND	ND	0.47	*Dry*
2002/11/26	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.13	ND	ND	ND	0.13	*Dry*
2002/12/12	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.05	*Dry*

LOCATION: SCARLETT WOODS GOLF COURSE STATION #4

Legend

DL - Detection Limit
WQC - Water Quality Criteria
NA - Not Analyzed For
ND - Not Detected
MDL - Detected but not Quantifiable
CYP - Cypermethrin
SIM - Simazine
DATR - des ethyl atrazine

Date	Imidacloprid	Glyphosate	Dithiopyr	Diazinon	Chlorpyrifos	CYP	SIM	Atrazine	DATR	Metribuzin	Carbofuran	Metolachlor	Bromacil	Dicamba	MCPP	2,4-D	MCPA	2,4-DB	Total Phen.	*Weather*
DL (ug/L) >	**1**	**50**	**10**	**0.02**	**0.05**	**0.05**	**0.05**	**0.02**	**0.02**	**0.05**	**0.1**	**0.05**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	
WQC (ug/L) >	**-**	**65**	**-**	**0.08**	**0.001**	**-**	**10**	**1.8**	**1.8**	**1**	**1.8**	**7.8**	**-**	**4**	**4**	**4**	**4**	**4**	**4**	
1998/06/09	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1998/09/14	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/03/31	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/05/05	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/06/01	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	MDL	ND	ND	0.10	*Wet*
1999/07/13	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/07/31	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/08/18	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/09/28	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/09/29	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	3.00	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/10/21	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/11/02	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.80	ND	ND	ND	0.80	*Wet*
2000/08/31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/09/23	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2000/09/27	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/11/02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/05/22	ND	ND	ND	0.09	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/06/08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/06/11	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/08/01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/09/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/09/20	ND	ND	ND	0.19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/09/25	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/10/12	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*

LOCATION: SCARLETT WOODS GOLF COURSE STATION #3

Date	Imidacloprid	Glyphosate	Dithiopyr	Diazinon	Chlorpyrifos	CYP	SIM	Atrazine	DATR	Metribuzin	Carbofuran	Metolachlor	Bromacil	Dicamba	MCPP	2,4-D	MCPA	2,4-DB	Total Phen.	Weather
1998/06/09	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1998/09/14	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/03/31	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/05/05	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/06/01	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/07/13	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/07/31	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	0.80	ND	ND	0.80	*Wet*
1999/08/18	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/09/28	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	MDL	0.80	ND	ND	ND	0.85	*Dry*
1999/09/29	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/10/21	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/11/02	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2000/08/31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.41	ND	ND	ND	0.41	*Dry*
2000/09/23	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2000/09/27	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/11/02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/05/22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/06/08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/06/11	ND	ND	ND	ND	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/08/01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/09/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/09/20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/09/25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/10/12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*

LOCATION: WEST DON RIVER

Legend

DL - Detection Limit
WQC - Water Quality Criteria
NA - Not Analyzed For
ND - Not Detected
MDL - Detected but not Quantifiable
CYP - Cypermethrin
SIM - Simazine
DATR - des ethyl atrazine

Date	Imidacloprid	Glyphosate	Dithiopyr	Diazinon	Chlorpyrifos	CYP	SIM	Atrazine	DATR	Metribuzin	Carbofuran	Metolachlor	Bromacil	Dicamba	MCPP	2,4-D	MCPA	2,4-DB	Total Phen.	*Weather*
DL (ug/L) >	**1**	**50**	**10**	**0.02**	**0.05**	**0.05**	**0.05**	**0.02**	**0.02**	**0.05**	**0.1**	**0.05**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	
WQC (ug/L) >	**-**	**65**	**-**	**0.08**	**0.001**	**-**	**10**	**1.8**	**1.8**	**1**	**1.8**	**7.8**	**-**	**4**	**4**	**4**	**4**	**4**	**4**	
1999/07/31	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	MDL	1.00	ND	ND	ND	1.05	*Wet*
1999/08/04	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.80	MDL	ND	ND	0.90	*Wet*
1999/08/18	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.90	ND	ND	ND	0.90	*Dry*
1999/09/28	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	1.00	ND	ND	ND	1.00	*Dry*
1999/09/29	NA	NA	NA	MDL	ND	ND	MDL	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/09/30	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/10/21	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/11/02	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/11/03	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.80	ND	ND	ND	0.85	*Wet*
2000/08/31	MDL	ND	ND	0.02	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/09/23	ND	ND	ND	0.18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.34	ND	ND	ND	0.34	*Wet*
2000/09/27	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.21	ND	ND	ND	0.21	*Dry*
2000/11/02	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.20	ND	ND	ND	0.20	*Dry*
2001/05/22	ND	ND	ND	0.27	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	1.20	0.95	ND	ND	2.15	*Wet*
2001/06/08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05	1.70	ND	0.75	ND	ND	ND	0.75	*Dry*
2001/06/11	ND	ND	ND	0.05	ND	ND	ND	0.14	ND	ND	ND	ND	0.33	ND	1.40	1.40	ND	ND	2.80	*Wet*
2001/07/17	ND	ND	ND	0.10	ND	ND	ND	MDL	ND	ND	ND	ND	0.23	ND	0.85	ND	ND	ND	0.85	*Wet*
2001/08/01	ND	ND	ND	0.06	ND	ND	ND	MDL	ND	ND	ND	ND	0.84	ND	0.70	ND	ND	ND	0.70	*Dry*
2001/08/17	ND	ND	ND	0.08	ND	ND	ND	MDL	ND	ND	ND	ND	0.30	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/20	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	ND	ND	0.55	ND	ND	ND	ND	ND	ND	*Wet*
2001/09/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/09/20	ND	ND	ND	0.17	ND	ND	ND	ND	ND	ND	ND	ND	0.14	ND	0.85	1.00	ND	ND	1.85	*Wet*
2001/09/25	ND	ND	ND	0.10	ND	ND	ND	ND	ND	ND	ND	ND	0.19	ND	1.00	1.40	ND	ND	2.40	*Wet*
2001/10/12	ND	ND	ND	0.07	0.52	ND	ND	ND	ND	ND	ND	ND	0.43	ND	ND	ND	ND	ND	ND	*Wet*

LOCATION: DON RIVER MOUTH

Legend		
DL - Detection Limit	NA - Not Analyzed For	CYP - Cypermethrin
WQC - Water Quality Criteria	ND - Not Detected	SIM - Simazine
	MDL - Detected but not Quantifiable	DATR - des ethyl atrazine

Date	Imidacloprid	Glyphosate	Dithiopyr	Diazinon	Chlorpyrifos	CYP	SIM	Atrazine	DATR	Metribuzin	Carbofuran	Metolachlor	Bromacil	Dicamba	MCPP	2,4-D	MCPA	2,4-DB	Total Phen.	*Weather*
DL (ug/L) >	**1**	**50**	**10**	**0.02**	**0.05**	**0.05**	**0.05**	**0.02**	**0.02**	**0.05**	**0.1**	**0.05**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	
WQC (ug/L) >	**-**	**65**	**-**	**0.08**	**0.001**	**-**	**10**	**1.8**	**1.8**	**1**	**1.8**	**7.8**	**-**	**4**	**4**	**4**	**4**	**4**	**4**	
1998/06/09	NA	NA	NA	0.11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1998/06/25	NA	NA	NA	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.89	ND	ND	ND	0.89	*Wet*
1998/06/30	NA	NA	NA	0.10	ND	ND	ND	ND	ND	ND	ND	1.30	ND	ND	1.10	1.10	ND	ND	2.20	*Wet*
1998/09/14	NA	NA	NA	0.01	ND	0.38	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/03/31	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/05/05	NA	NA	NA	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.05	*Dry*
1999/05/19	NA	NA	NA	0.30	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	MDL	ND	ND	ND	0.10	*Wet*
1999/06/01	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	1.70	1.40	ND	ND	3.15	*Wet*
1999/07/13	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/07/31	NA	NA	NA	0.30	MDL	ND	ND	ND	ND	ND	MDL	ND	ND	MDL	1.00	ND	ND	ND	1.05	*Wet*
1999/08/04	NA	NA	NA	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.60	ND	ND	ND	0.65	*Wet*
1999/08/18	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.90	ND	ND	ND	0.90	*Dry*
1999/09/09	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/09/28	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	MDL	1.00	0.70	ND	ND	1.75	*Dry*
1999/09/29	NA	NA	NA	0.50	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	MDL	ND	ND	MDL	0.10	*Wet*
1999/09/30	NA	NA	NA	1.00	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/10/21	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/11/02	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/11/03	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	1.00	ND	ND	ND	1.05	*Wet*
2000/07/17	ND	ND	ND	0.31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/08/13	ND	ND	ND	0.24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.17	0.21	ND	ND	0.38	*Dry*
2000/09/07	ND	ND	ND	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.28	ND	ND	ND	0.28	*Dry*
2000/09/23	ND	ND	ND	0.14	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.38	ND	ND	ND	0.43	*Wet*
2000/10/08	ND	ND	ND	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.52	ND	ND	ND	0.57	*Dry*
2000/11/06	ND	ND	ND	0.14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/11/10	ND	ND	ND	0.25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.46	ND	ND	ND	0.46	*Wet*
2000/12/05	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/04/30	ND	ND	ND	0.08	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	0.70	1.60	ND	ND	2.30	*Dry*
2001/05/22	ND	ND	ND	0.22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.00	1.10	ND	ND	2.10	*Wet*
2001/05/23	ND	ND	ND	0.25	ND	ND	ND	0.10	ND	ND	ND	0.11	ND	MDL	0.85	ND	ND	ND	0.90	*Dry*
2001/05/29	ND	ND	ND	0.12	ND	ND	ND	0.05	ND	ND	ND	ND	ND	MDL	0.95	ND	ND	ND	1.00	*Dry*
2001/06/08	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	0.23	ND	0.70	ND	ND	ND	0.70	*Dry*
2001/06/11	ND	ND	ND	0.11	ND	ND	ND	0.06	ND	ND	ND	ND	0.15	ND	1.00	1.10	ND	ND	2.10	*Wet*
2001/07/17	ND	ND	ND	0.29	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	1.00	ND	ND	ND	1.00	*Wet*
2001/08/01	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/01	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/17	ND	ND	ND	0.09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.10	ND	ND	ND	1.10	*Dry*
2001/08/20	ND	ND	ND	0.14	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.70	0.90	1.40	ND	ND	3.00	*Wet*
2001/09/20	ND	ND	ND	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.10	ND	ND	ND	1.10	*Wet*
2001/09/25	ND	ND	ND	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.80	ND	ND	ND	0.80	*Wet*
2001/10/12	ND	ND	ND	0.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2002/02/26	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2002/05/09	NA	NA	NA	0.01	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2002/05/13	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.05	*Wet*
2002/05/27	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.05	*Dry*
2002/06/03	NA	NA	NA	0.01	ND	ND	ND	MDL	ND	ND	ND	ND	ND	MDL	MDL	ND	ND	ND	0.10	*Dry*
2002/06/17	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.05	*Dry*
2002/06/27	NA	NA	NA	0.01	ND	ND	ND	ND	MDL	ND	ND	ND	ND	MDL	0.55	0.55	ND	ND	1.15	*Wet*
2002/07/08	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2002/07/31	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.05	*Dry*
2002/08/15	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.62	0.83	ND	ND	1.45	*Dry*
2002/08/28	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.05	*Dry*
2002/09/16	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.40	ND	ND	ND	2.40	*Dry*
2002/09/26	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.59	ND	ND	ND	0.59	*Dry*
2002/10/07	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.10	ND	ND	ND	1.10	*Dry*
2002/10/22	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.20	0.47	ND	ND	0.67	*Wet*

LOCATION: DON RIVER MOUTH

Legend		
DL - Detection Limit	NA - Not Analyzed For	CYP - Cypermethrin
WQC - Water Quality Criteria	ND - Not Detected	SIM - Simazine
	MDL - Detected but not Quantifiable	DATR - des ethyl atrazine

Date	**Imidacloprid**	**Glyphosate**	**Dithiopyr**	**Diazinon**	**Chlorpyrifos**	**CYP**	**SIM**	**Atrazine**	**DATR**	**Metribuzin**	**Carbofuran**	**Metolachlor**	**Bromacil**	**Dicamba**	**MCPP**	**2,4-D**	**MCPA**	**2,4-DB**	**Total Phen.**	***Weather***
DL (ug/L) >	**1**	**50**	**10**	**0.02**	**0.05**	**0.05**	**0.05**	**0.02**	**0.02**	**0.05**	**0.1**	**0.05**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	
WQC (ug/L) >	**-**	**65**	**-**	**0.08**	**0.001**	**-**	**10**	**1.8**	**1.8**	**1**	**1.8**	**7.8**	**-**	**4**	**4**	**4**	**4**	**4**	**4**	
2002/11/06	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.11	0.29	ND	ND	0.40	*Wet*
2002/11/12	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.13	ND	ND	ND	0.13	*Dry*
2002/11/26	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.13	ND	ND	ND	0.13	*Dry*
2002/12/12	NA	NA	NA	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	0.05	*Dry*

LOCATION: WILKET CREEK

Legend			
	DL - Detection Limit	NA - Not Analyzed For	CYP - Cypermethrin
	WQC - Water Quality Criteria	ND - Not Detected	SIM - Simazine
		MDL - Detected but not Quantifiable	DATR - des ethyl atrazine

	Imidacloprid	Glyphosate	Dithiopyr	Diazinon	Chlorpyrifos	CYP	SIM	Atrazine	DATR	Metribuzin	Carbofuran	Metolachlor	Bromacil	Dicamba	MCPP	2,4-D	MCPA	2,4-DB	Total Phen.	*Weather*
DL (ug/L) >	**1**	**50**	**10**	**0.02**	**0.05**	**0.05**	**0.05**	**0.02**	**0.02**	**0.05**	**0.1**	**0.05**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	
WQC (ug/L) >	**-**	**65**	**-**	**0.08**	**0.001**	**-**	**10**	**1.8**	**1.8**	**1**	**1.8**	**7.8**	**-**	**4**	**4**	**4**	**4**	**4**	**4**	
1998/06/09	NA	NA	NA	0.06	ND	ND	ND	ND	1.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1998/06/30	NA	NA	NA	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.10	1.20	ND	ND	2.30	*Wet*
1998/09/14	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/03/31	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/05/05	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/06/01	NA	NA	NA	0.40	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	MDL	ND	ND	ND	0.10	*Wet*
1999/07/13	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/07/31	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	MDL	ND	ND	MDL	0.80	ND	ND	ND	0.85	*Wet*
1999/08/18	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.90	ND	ND	ND	0.90	*Dry*
1999/09/28	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	MDL	0.90	ND	ND	ND	0.95	*Dry*
1999/09/29	NA	NA	NA	0.40	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
1999/10/21	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
1999/11/01	NA	NA	NA	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2000/08/31	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/09/23	ND	ND	ND	0.18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.31	ND	ND	ND	0.31	*Wet*
2000/09/27	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.14	ND	ND	ND	ND	0.14	*Dry*
2000/11/02	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/05/22	ND	ND	ND	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.75	0.80	ND	ND	1.55	*Wet*
2001/06/08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.75	ND	ND	ND	0.75	*Dry*
2001/06/11	ND	ND	ND	0.14	ND	ND	ND	MDL	ND	ND	ND	0.06	ND	ND	0.85	1.20	ND	ND	2.05	*Wet*
2001/07/17	ND	ND	ND	0.38	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/08/01	ND	ND	ND	MDL	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/17	ND	ND	ND	0.11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/20	ND	ND	ND	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*
2001/09/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/09/20	ND	ND	ND	0.09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.70	3.20	ND	ND	4.90	*Wet*
2001/09/25	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.95	ND	ND	ND	0.95	*Wet*
2001/10/12	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*

LOCATION: BURKE BROOK

Legend		
DL - Detection Limit	NA - Not Analyzed For	CYP - Cypermethrin
WQC - Water Quality Criteria	ND - Not Detected	SIM - Simazine
	MDL - Detected but not Quantifiable	DATR - des ethyl atrazine

Date	Imidacloprid	Glyphosate	Dithiopyr	Diazinon	Chlorpyrifos	CYP	SIM	Atrazine	DATR	Metribuzin	Carbofuran	Metolachlor	Bromacil	Dicamba	MCPP	2,4-D	MCPA	2,4-DB	Total Phen.	*Weather*
DL (ug/L) >	**1**	**50**	**10**	**0.02**	**0.05**	**0.05**	**0.05**	**0.02**	**0.02**	**0.05**	**0.1**	**0.05**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	
WQC (ug/L) >	**-**	**65**	**-**	**0.08**	**0.001**	**-**	**10**	**1.8**	**1.8**	**1**	**1.8**	**7.8**	**-**	**4**	**4**	**4**	**4**	**4**	**4**	
2000/08/31	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/09/23	ND	ND	ND	0.12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.55	ND	ND	ND	0.55	*Wet*
2000/09/27	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2000/11/02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/05/22	ND	ND	ND	0.32	ND	ND	ND	0.05	ND	ND	ND	ND	ND	ND	0.95	0.90	ND	ND	1.85	*Wet*
2001/06/08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/06/11	ND	ND	ND	0.09	ND	ND	ND	MDL	ND	ND	ND	MDL	ND	ND	0.70	1.00	ND	ND	1.70	*Wet*
2001/08/01	ND	ND	ND	ND	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/08/17	ND	ND	ND	MDL	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/09/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Dry*
2001/09/20	ND	ND	ND	0.10	ND	ND	ND	MDL	ND	ND	ND	ND	ND	ND	0.90	1.30	ND	ND	2.20	*Wet*
2001/09/25	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.80	0.75	ND	ND	1.55	*Wet*
2001/10/12	ND	ND	ND	0.09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*Wet*